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THE GAL OYA WATER MANAGEMENT PROJECT:

END-OF-PROJECT IMPACT ASSESSMENT

Report Prepared for;

Government of Sri Lanka
Ministry of Lands and Land Development
Irrigation Department and
Irrigation Management Division

and

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I INTRODUCTION

1.1 Irrigation Development in Sri Lanka

Sri Lanka has had a strong tradition of tank irrigation using elaborate network of channels, and the historical evidence shows that, from about the 5th century to the 15th, irrigation activities played a crucial role in sustaining the ancient empires. However, for reasons yet unclear, the great hydraulic civilization began to fade away from about the 15th century.

Serious state interest for reviving the domestic agriculture through development of irrigation infrastructure began to reappear only at the beginning of this century. Since the establishment of the Irrigation Department (ID) in 1900, the development of irrigation infrastructure has received a higher priority among overall development strategies: the main objective was to restore and develop as many irrigation reservoirs as possible. Since then, and for more than half a century the government sponsored irrigation-based colonization (or resettlement) programme played a vital role in the social and economic life of the people of the country. The major emphasis in this process was on capturing the maximum possible quantity of water from a watershed and arranging physical infrastructure to settle the maximum number of families brought in from densely populated wet zone areas or (in some cases) from neighbouring villages. The present paper is focussed on such a settlement scheme, namely the Gal Oya Irrigation Scheme.

In the recent past, the development of irrigation infrastructure has absorbed a major share of development budgets. For example, during the period 1955 - 1980, the expenditure on irrigation as a proportion of total government expenditure increased by about five fold. During the same period, the area under irrigation rose from about 650,000 acres to over 1,200,000 acres.

1.2 The Need for Rehabilitation and the Emphasis on Water Management

The performance of most of these systems, despite their very high costs of construction, has fallen short of expentations and was characterized by their inability to serve properly all the farmers within their respective command areas. The increased pressure of population on cultivable land, inadequate operation and maintenance schedules and even faulty designs would have contributed to this state of affairs.

Many of these irrigation schemes were characterized by their inability to serve properly all the farmers within their respective command areas. As a consequence, unequal, inadequate and unreliable distribution of water has become common phenomenon in Sri Lanka. (Murray-Rust, 1983; Wijayaratna, 1982; Svendsen and Wijayaratna, 1982).

Consequently, by about the end of 1970's there was a growing concern about the "deterioration" of existing irrigation systems, the need to rehabilitate these systems and to improve their management, operation and maintenance.

In late 1970's the government of Sri Lanka, with the assistance of some donor agencies, was concerned in exploring the possibilities of improving the water use efficiency and overall performance of existing irrigation systems,

In 1978, the U.S. Agency for International Development (USAID) decided to assist the Government of Sri Lanka (GSL) to improve the management of water in major irrigation projects in the Dry Zone. It was understood that this required building an adequate knowledge-base and new institutional capacities, both of which take time and neither of which can be purchased 'off the shelf'. USAID and GSL recognized that a successful effort

to improve water management could well take 20 years, but it would have to begin in a focused, concrete way, in a pioneering project that would begin to build up in-country knowledge and institutional capacity.

USAID engaged a private American consulting firm, CH2M Hill, to make a study to define the scope and content of a programme of action in water management. During October and November 1978, a five-member team consisting of an agricultural engineer, agricultural economist, sociologist, irrigation engineer and soil scientist spent 7 weeks in Sri Lanka drawing upa a proposed programme. The team observed that there was a very low level of water control and management in major irrigation systems. Hence it concluded that the potential for economic and social benefits from improved water management was very high. If excessive and wasteful use of water in headend areas could be reduced, downstream areas could be better irrigated, and some unirrigated areas could be brought into production, that food output could be increased and incomes would be more equitably distributed.

According to the findings of the CH2M Hill team, the following factors contributed to the undesirable situation in major irrigation schemes:

a. Scarce resources are directed to the completion of new construction projects rather than to efficient operation and maintenance of existing schemes.

b. Insufficient attention is given at the design stage to operational requirements.

c. Budgets for operation and maintenance are inadequate.

d. The professional staff of government agencies managing irrigation scheme receive insufficient training in water management.

e. Disproportionate attention is given to design and construction activities because of the structure of professional rewards.

f. Rewards for good perfromance in operation and maintenance of irrigation systems are inadequate.

g. Cultivators help themselves to as much water as they think they need or are entitled to.

h. Staff responsible for water management are not provided with authority and support needed to ration water. Relationships between farmers and government agencies are generally not good.

i. Farmers' organizations for water management are non-existent or are not playing constructive roles.

j. For many of the above reasons, there has been a substantial deterioration of physical structures in irrigation schemes, including disappearance of control gates, erosion of control and check structures, erosion of channel banks and bunds, siltation of channels, and illegal takeout points, Laws regarding damage to government facilities or misuse of water have not been enforced.

The team found that the following are the major needs for the improvement of water management in major irrigation schemes:

a. Substantial physical rehabilitation of systems.

b. Installation of control and measurement devices.

c. Increase in operation and maintenance budgets, and recognization of agencies responsible for the management of irrigation schemes.

d. Increased political and administrative support for water management.

e. Increased funds and emphasis on training of agricultural extension personnel and farmer extension programmes for improving water management.

f. Use of systems approach to operating projects, with improved training to provide greater expertise on the part of present professional staff, and increases in the number of persons trained in water management.

g. Research and experimentation on farm layouts, field channel design and cropping patterns aimed at water saving.

The CH2M Hill team proposed a water management programme under which the GSL with USAID assistance would improve water management in major irrigation systems beginning with a pilot project in Gal Oya or Uda Walawe. The selected scheme would be physically rehabilitated, with an improved training programme, assistance in improving the extension programme, expanded central support to the ID, and a programme of socio-economic research. All of these elements were to provide direct and indirect benefits to the farmers in major irrigation schemes.

With regard to farmers, the main recommendation was to improve the comprehensiveness and enforcement of laws regulating irrigation performance. However, USAID proposed inclusion of an experimental component in the project to introduce farmer organization for improving water management among farmers and in conjunction with government personnel.

This recommendation was based on experience in some other Asian countries, notably the Philippines and Pakistan.

The GSL decoded to carry out the pilot project in the Gal Oya scheme, in part because it was the largest and most in need of physical rehabilitation, being 30 years old, the first scheme constructed after independence by the Government of Sri Lanka (then Ceylon).

1.3 Gal Oya Irrigation Scheme and the Water Management Project

Gal Oya Irrigation Scheme (henceforth referred to as Gal Oya) is located in the eastern dry zone of Sri Lanka, (Figure 1) and covers a geographical area of about 1550 sq.km. (600 sq. miles). The capacity of the main reservoir is 950 million cubic meters (770,000 ac. feet).

The intake tower which releases water from the reservoir leads to a trifurcation structure with release controls for the Left Bank (LB), Right Bank (RB) and the River Division (RD) of the Gal Oya system. (Figure 2). The system has a network of main canals, supplementary tanks, distributary channels (D-channels), and field channels necessary to irrigate a planned potential area of about 49,000 ha. (120,000 ac.). In 1981, the estimated service area under LB, RB and RD were 24,300 ha., 11,100 ha. and 11,300ha. (60,000, 27,500 and 28,000 ac.) respectively.

The focus of the irrigation rehabilitation and betterment programme was on the LB system. The LB channel system, whose command area is mostly in paddy, is estimated to consist of nearly 52 Km. of main canals, 145 Km. of major distributaries, 445 Km. of minor distributaries and approximately 680 Km. of field channels. A schematic diagram of channel flow in LB is illustrated in Figure 3.

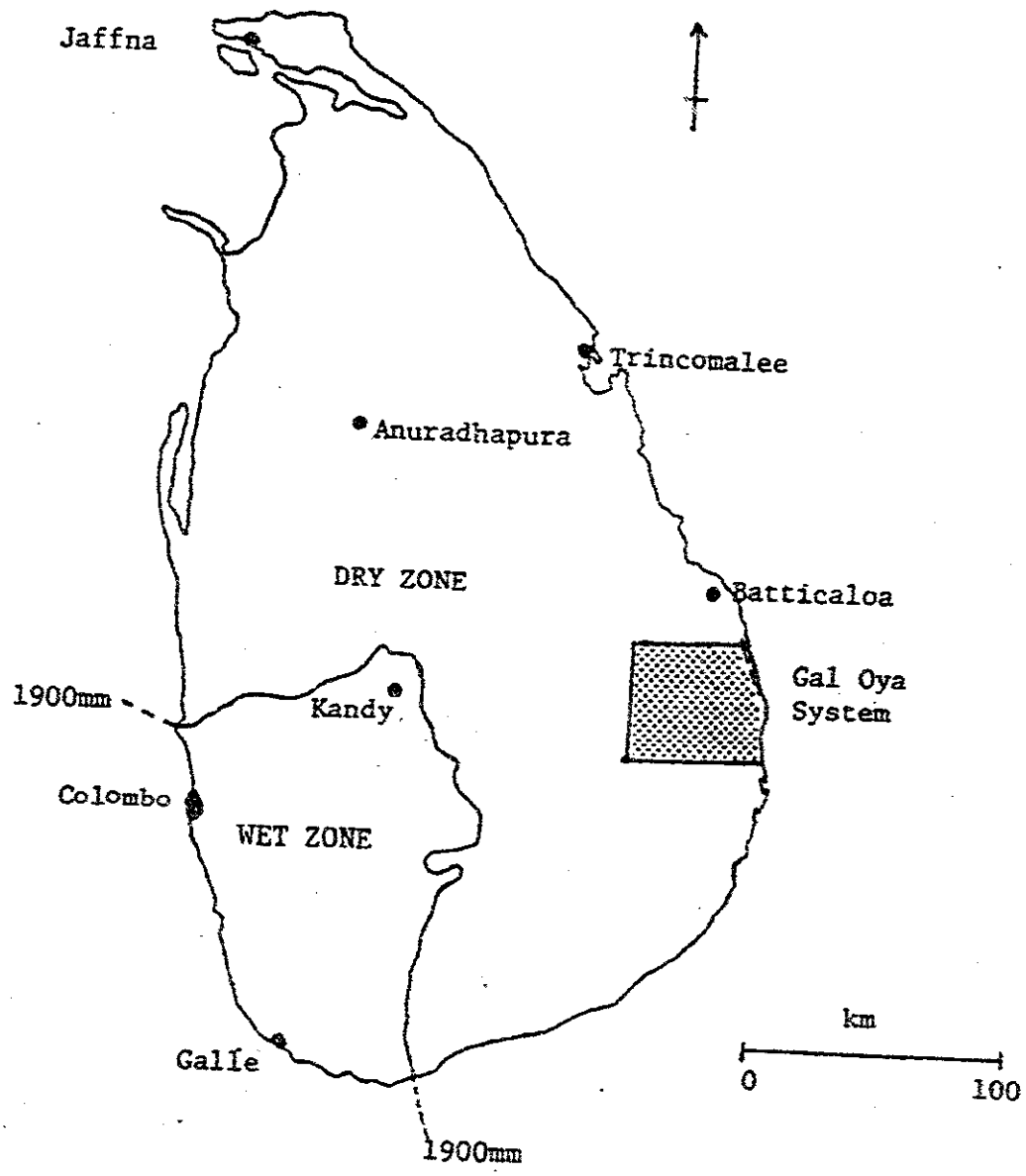


Figure 1 .1: Location of the Gal Oya Irrigation System

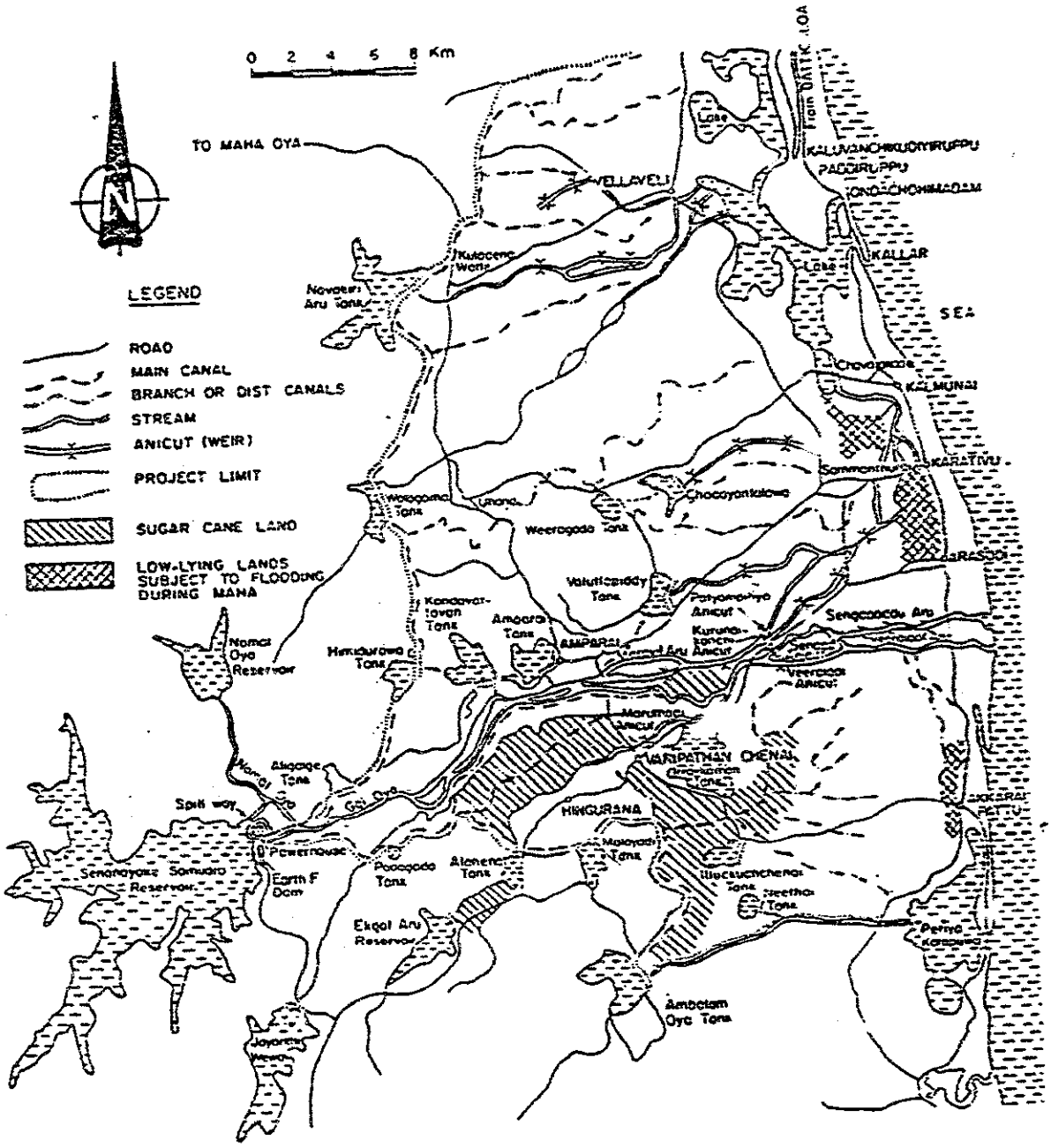
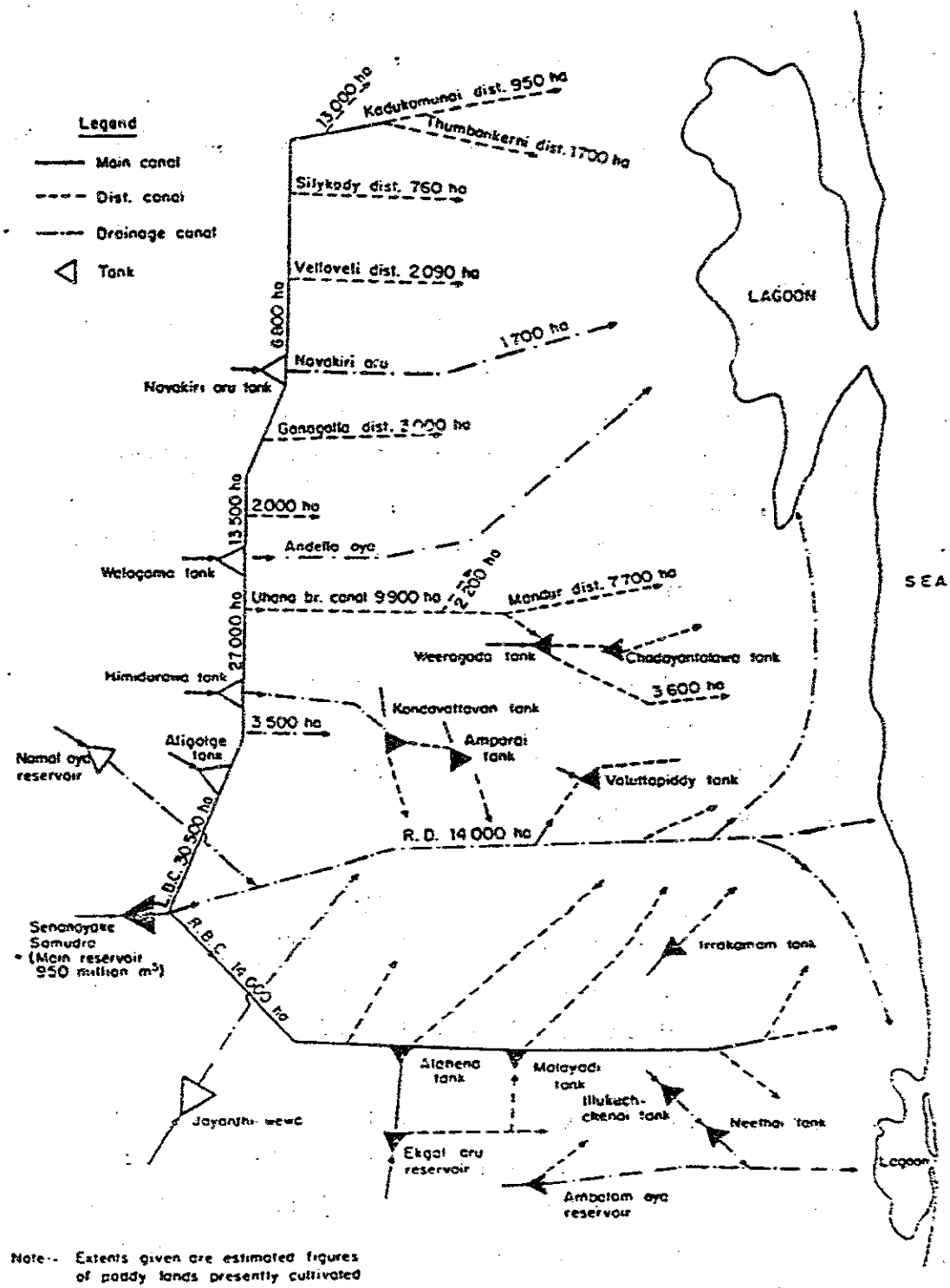


Figure 1.2: Gal Oya Project Lay-Out



Note:- Extents given are estimated figures of paddy lands presently cultivated

Figure 1.3: Gal Oya Project Channel Flow (schematic)

The major reservoir and the main distribution system were completed in 1952 and, about the same time, the first phase of "colonization" was commenced. By 1965, an estimated area of about 18,000 ha. (44,500ac.) was under irrigation in the LB command and this had provided aliving to about 12,000 households[1].

Serious deterioration of the physical system and inadequate water distribution were the major reasons for selecting Gal Oya for a major rehabilitation effort by GSL and USAID. Status of the project in regard to operation and maintenance (O & M), structures, socio-economic conditions of beneficiaries etc. are well documented in many of the pre-rehabilitation studies (ARTI, 1982, 84, 85; Wijayaratna 1982a, 82b, 83, 84 and 86, PRC - ECI Inc. Master Plan, unpublished, Svendsen & Wijayaratna 1982; and Hammond Murray-Rust, 1983).

USAID accepted the selection of Gal Oya Left Bank for rehabilitation and an agreement was signed on 30th August 1979 between the GSL and USAID to provide funds for the Gal Oya Water Management Project as follows:

USAID		GSL	Total
Loan	Grant	(Local costs)	
6.8	3.0	8.5	18.3

(All in millions of US Dollars)

As originally conceived by the CH2M Hill consultants, the project would extend for 8 years, but in the final formulation it was telescoped into 4 years. As the volume of work and cost proved to have been underestimated and as some additional related tasks became evident in the course of implementation, the project was extended through December 31, 1985, with additional funding from USAID of $ 6.1 million and from GSL $ 6.1 million in rupees.

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1 - By 1981, the command area has been increased by about 35 percent and the population was about 125,000 (over 20,000 households).

The major component of the project was physical rehabilitation, which colored the whole project so that it, at least initially, was interpreted more as a rehabilitation project than as one dedicated to improving water management as such. Indeed, the project inauguration invitation listed it as the Gal Oya Rehabilitation Project. A second component was master planning for the Gal Oya and Uda Walawe schemes, which became less salient when the project life was shortened so that the planning was done concurrently with (and to some extent after) the rehabilitation work. This study makes no attempt to assess the master planning component. A third component was to enhance the Irrigation Department's management capabilities, particularly through training though also through improved communication facilities, computer programming and other inputs. The renovation and upgrading of the Irrigation Training Institute at Galgamuwa with a full range of courses was the major part of this component. A fourth component was the introduction of farmer organization throught the efforts of Institutional Organizers (IOs) as noted above and as evaluated at some length in this report. A fifth component was special studies, particularly socio-economicstudies though also some experimentation of an agronomic nature. A sixth set of activities was to improve the provision of agricultural inputs, credit, marketing and extension, agreed upon in a supplementary plan but implemented separately from the project. This is also outside the scope of our assessment though its contribution should be reflected in evaluation of agricultural production (Chapter III), including changes in agricultural practices and returns to inputs.

The Irrigation Department (ID) was assigned responsibility for implementation of the project by the Government of Sri Lanka. It was advised and assisted in the technical aspects by a team of consultants provided under a contract with the American firm, PRC/ECI, which had been consultants in the Mahaweli project in the late 1960s and thus had several years of experience working

in Sri Lanka. The Agrarian Research and Training Institute (ARTI) was subcontracted by the ID to handle the socio-economic aspects of the project, including primarily the experimentation with farmer organizations and the socio-economic studies. The Rural Development Committee, and later the Irrigation Studies group of Cornell University was provided through USAID/Washington as consultants to ARTI and specifically engaged under this project for long-term consultancies in the social science area with both American and Sri Lankan consultants supporting ARTI's work. In 1983, a mid-project impact assessment was conducted by ARTI at the request of the ID and USAID. As part of the regular project cycle, the USAID mission in Sri Lanka contracted with an outside consulting firm, the Institute for Science and Technology International (ISTI) based in Washington, D.C. to do an end-of-project evaluation in November-December 1985. This was necessarily constrained by time and the team members had little prior acquaintance with Sri Lanka or Gal Oya. Accordingly, ARTI with Cornell assistance planned and conducted this more in-depth evaluation to shed light on the project's impact and to try to extract lessons to be learned from this experience for future efforts to improve water management in Sri Lanka.

The two main components to be evaluated as inputs to the project are (a) the physical rehabilitation, and (b) the farmer organizations, treated respectively in Chapters 1 and 2. Each could have certain impacts on water management capacity and performance, which can be identified and assessed. Our competence to assess the first is limited, though we had the services of Dr. H.C. Kariyawasam as a member of the study team, who as an engineer and as one of the original project managers for this project could contribute some technical information to the assessment. This assessment, however, is limited in scope, focusing on changes in conveyance, control and measurement capacities. The farmer organizations, on the other hand, are very much within our area of competence as they were within out

area of responsibility. As throughout the project, we have tried to maintain a demonstrable degree of objectivity and self-criticism, which we think contributed to the progress of this component, we have tried to maintain this stance in looking at component impact now.

These two components together should create physical and institutional capacity at lower levels of the system for more rational application of water to irrigated crops. There is a complementary component, increased management capacity within the Irrigation Department, for planning and implementing water distribution, which could be assessed separately, but we are not in a good position to do this. We note and have personally experienced the improvements made in the Galgamuwa Irrigation Training Institute, which has for example complemented and supported the farmer organization efforts. The introduction of computer programming and monitoring for water flows in the Gal Oya Left Bank (GOLB) has made a very positive contribution to the operation of the system. But detailed assessment of this is beyond our capacity, and besides should show up in the assessment of project impact on production. Much the same can be said of the complementary agricultural plan, which we have not tried to assess independently, looking at availability of inputs and amount of extension efforts made, since our assignment was to look more at impact. We do have data on changes in farmer uses of inputs, credit, etc. which reflect performance in this domain.

We focus attention on what if any changes can be documented in the areas of : (a) water distribution (Chapter 3), (b) agricultural production, both the process and the outputs thereof (Chapter 4) and, (c) whatever evidence there is of broader socio-economic changes attributable to project activity (Chapter 6). We also assess the comparison of economic costs and benefits from the project with more data and considerations analysed than were taken into account in the ISTI evaluation (Chapter 5).

PHYSICAL REHABILITATION

As can be seen from the cost estimate of the original project proposal, about 75% of the total cost of the project was allocated for physical rehabilitation. The major objectives of physical rehabilitation were:

a. To increase the water conveyance capacity of the irrigation system which had been substantially reduced as a result of siltation and erosion.

b. To improve the water control capacity of the system, so that excess deliveries could be reduced and water could be distributed to the eligible areas in a more reliable and equitable manner.

c. To improve the water measurement capacity of the system, so that operators could know how much water was flowing where and could take steps to deliver appropriate amounts.

For such improvements in the physical structure to pay off, it is necessary to enhance the management capability of the Irrigation Department, so that staff can and will utilize the resulting structures for more efficient water distribution. This involves training in monitoring and measuring flows, in planning distribution schedules, in communicating and getting feedback about system operation, etc. We have not attempted to assess changes in such operational capabilities, as stated in introduction, but we would note that overall levels of system performance, based on physical rehabilitation and cooperation with and among farmers, have greatly improved. The water duty for the Left Bank for Maha 1984/85 and 1985/86 has been about 2 acre-feet, which compares favourably with the national 'norm' of 3 acre-feet, often exceeded. At the time the project was

started, the Irrigation Engineer responsible for water distribution reported in a paper that the Maha level planned for GOLB was 5 acre-feet, and that for Yala was 8 acre-feet. The 1985 Yala water duty for GOLB was 5.15 acre-feet, as reported in Chapter 6, with practically the whole extent of the Left Bank cultivated and with practically complete farmer cooperation and satisfaction. So without going into a detailed analysis of changes in management capability, we can say that these seem to have been substantial and quite satisfactory, based on gross but definitive measures of system performance. Accordingly we are satisfied that a narrower look at the impact of physical rehabilitation on physical capacities is sufficient.

The task of physical rehabilitation included:

a. Removal of silt and restoration of eroded banks on the Left Bank main canal, the branch and distributary canals and the larger (longer) field channels.

b. Repair and replacement of control gates; repair or construction of regulators and other structures in the canal/channel system.

c. Repair and installation of measuring devices, and recalibrating or calibrating measurement structures/techniques, such as rating curves which could have become obsolete from changes in channel configurations and flows.

The methodology for impact assessment adopted was to estimate increased cross-sectional area of canals to evaluate effects on conveyance capacity. This was also established from the data collected by PRC/ECI in preparing rating curves for the main and branch canals. The number of control points at the head, middle and tail of the system before and after rehabilitation was used to estimate changes in control capacity of the

system. The number of measuring structures before and after the project gives an indication of changes in the measurement capacity. How these structures are used, and how often and how effectively, is of course a separate question in the realm of management capacity. But as indicated above, there is evidence that improvements have been made in this.

Conveyance Capacity

The most important physical feature of an irrigation system is its capacity to convey water because without this, control and measurement have little meaning. According to estimates made by FAO in 1976, the conveyance capacity of the Left Bank main canal was only 850 cusecs, compared to the designed discharge capacity of 1150 cusecs. This means there was a 30% reduction in the designed capacity due to siltation and other deterioration. Since the area that can be irrigated by a system is directly proportional to discharge, this meant a direct reduction of 30% in effective command area. (However, limitations in supply from the reservoir catchment area were more often a constraint on area served than was main canal conveyance capacity).

Conveyance capacity on subsidiary canals had been reduced by as much as 50%, making corresponding reductions in effective command area within sub-systems of the Left Bank. The main reason for this was accumulation of silt. The main canals had not had any systematic desilting work done on them through 1977. When the Irrigation Department took levels and cross-sections of the canals in 1976, it estimated the amount of desilting needed to be as given in Table 1.

Table 1 : Accumulation of Silt in Main and Branch Canals (in cubic yards)

Canal	Length(Mi.)	Silt
Left Bank Main	32	675,000
Uhana & Mandur	13	230,000
LB 22	4	32,000
Gonagolla	8	80,000
Total		1,017,000

These figures mean that the space available for the flow of water had been reduced by 1 million cubic yards of silt. This situation was ameliorated by the fact that most of the cross-sections of canals had become larger than their designed area, due to erosion which had caused the accumulation of silt. At some places, the bed width of the main canal was twice the design width. So conveyance capacity was not directly reduced by this much, but indirectly by slowing the flow in the canal, siltation could increase conveyance loses due to seepage and percolation.

It was observed that there were about 3/4 of a cubic foot per linear foot of field channels. However, this was often the accumulation from just one season, between channel cleanings by farmers. Due to the condition of social disorganization prevailing in GOLB prior to the project, it was reported that some field channels and distributaries had not been cleaned for 5, 10 even 20 years, in which case the accumulation fo silt would have been much greater, with attendant reduction in capacity.

From a sample survey, the amount of silt removed under the project is given in Table 2, This gives an idea of extents of

siltation. Since most of the desilting in the field channels was done by farmers manually, exact figures cannot be known.

Table 2 : Silt Removed in Distributary Canals (in cubic meters per kilometer)

Main/Branch Area	Silt Removed
Uhana	729
Gonagolla	623
Left Bank	279
Mandur	659
Silikkody	241
Chadyantalawa	320

However, based on the number of person-days put in by farmers in Uhana and Gonagolla areas in desilting, it is estimated that farmers there removed about 10,000 cubic yards of silt. Additionally, there was desilting of drainage channels needed to be done (ignored completely in the consultant estimate by T. Taylor of amount of silt to be removed, on the basic of which equipment for the project was ordered).

As a result of the silt removal and reshaping of canals, the conveyance capacity of the GOLB system has definitely increased. From current meter readings taken by PRC/ECI personnel, it appears that conveyance capacity of the main canal has been restored to the designed capacity of 1150 cusecs. Branch and distributary channels as well as field channels must have had conveyance capacity restored satisfactorily as farmers in both Maha and Yala season 1985 did not report water shortages anywhere in the LB system, provided that there was farmer cooperation in rotating water flows among and within D-channels when necessary to increase the head of water reaching fields.

Control Capacity

Before rehabilitation, it was possible to control the flow of water at only a few locations in the Left Bank system. The CH2M Hill team found about three-quarters of the D-channel and field channel gates broken, missing or inoperable. The field research by Hammond Murray-Rust in 1981 found water flows being measured and controlled on a fairly regular basis at only 7 points in the system. Efforts were not made to conserve water except with respect to maintaining an adequate head to generate electricity from the powerhouse at the head-works.

The situation has changed substantially after the project. Figure 1 shows the location of gates in the distributary channel UB 2 now, whereas before the project, there were no gates in the channel. In this particular channel, the quality of construction is good. It has been observed that the quality of construction has gone down toward the tail of the system, for example, in the Mandur area compared to that in Uhana. The density of control structures per kilometer and per hectare is shown in Table 3.

Table 3 : Control Structures in Various Left Bank Channels

D-Channel	Number of Control Structures	
	per Km.	per Ha.
UB 2	4.4	4.2
UB 15	2.1	8.8
G 3	5.6	10.7
G 11	4.4	9.0
G 14	2.3	7.1
LB 2	4.2	5.3
LB 19	3.5	4.4
LB 29	3.4	6.3
M 6	2.8	3.9
M 22	3.6	6.2
S 3	3.8	10.4
S 8	6.0	15.7

From Table 3 it can be seen that the distribution of control points as measured in terms of control structures per hectare of command area and per kilometer of length are reasonably uniform throughout the system. Silikkody area towards the tail of the system has the highest number of structures per hectare, though this reflects the lower ratio or area served to channel length. Some drop-off can be seen in the density of control structures as one goes down the Gonagolla branch canal, which may reflect time and budget constraints as this was the last area to get rehabilitation before the end of 1985.

Overall it can be said that control capacity at all levels of the physical system has increased substantially. All branch canals and D-channels have working control structures, with higher quality cast iron gates compared to previous timber gates. The ruggedness of D-channel gates has been questioned as these are held in place by pins that are easily removeable unless welded. The design and construction of cross-regulators appears to be reasonably adequate to maintain proper levels and heads, though some additions or adjustments may still be necessary for best regulation of flows.

Measuring Capacity

Prior to the project, there was negligible measuring capacity within the GOLB. Measurements were taken regularly only at four locations, at the head of the Left Bank main canal and of Uhana, Gonggolla and Mandur branch canals. But these measurements were not reliable because they were based on rating curves that had not been updated since 1960, so the volumes indicated were hardly correct. The rating curves had been prepared from a theoretical sluice equation and not varified using current meters. The actual discharge, therefore, could have been as little as 70% of the theoretical discharge, especially on canals where there was much silt accumulation. Misunderstandings over farmer

complaints about not being given enough water prior to rehabilitation are thus quite understandable.

One of the major objectives of the projects was to install measuring structures in the system so that water going into each D-channel and each field channel could be measured. Consultants under the project prepared rating curves for several locations on the main and branch canals, and thiw was one of the most useful things done under the project. By using current meters, considerably more accurate curves could be produced than by relying on theoretically derived curves, which usually indicated higher discharges than actual, which worked to the disadvantage of farmers.

Measuring structures were installed for most D-channels, but more were installed for field channels at the head of the system than in the tail. For example, every field channel on UB 2 has a measuring structure where as there no such structures were installed for several D-channel off the Mandur branch canal (M 6, M 10, M 25 and several others). This might be justified in terms of needing to measure flows at the head in order to curb waste and thereby gain water to be sent to the tail. On the other hand, downstream channels need to be able to document their flows in order to make claims for water they are entitled to.

The pattern observed may reflect over investment at the head and under-investment at the tail arising from differentials in time and budget available during the course of rehabilitation.

There are several types of measuring structures used in the system. In the head areas, the most common structure is the sharp crested weir. It was observed that such structures were damaged by farmers on several occasions when they appeared to be obstructing flows of water judged inadequate. It so happened

that ARTI as part of its water measurement training efforts had taken some measurements from these structures and it was determined that the rate of flow, due to errors in construction, was as little as 25% of designed discharge in two instances. So such structures are not only vulnerable but may invite damage due to improper construction. In several cases, ID engineers approved the breaking of these structures.

Subsequently, broad-crested weirs were constructed instead. These are difficult for anyone to damage because of their design. However, it was observed that some of these weirs have not been built exactly according to design specifications. This can be due to the complex nature of the structure or due to lack of experience of small-scale contractors with technical drawings. In any case, it is not possible to use standard curves for measuring discharges. Therefore, to have accurate water measurements it is necessary to prepare specific discharge rating curves for each structure using a current meter. This will involve a lot of time and be an expensive exercise. A water measurement programme which does not produce accurate numbers is of course useless.

Parshall flumes were constructed at several locations for measuring water on larger channels. No pafticular problems were observed with these.

Measuring structures are redundant unless measurements are taken and recorded. In our review of the status of measurement capacity in GOLB, four different kinds of gaps in such capacity were identified.

a. Measuring structures not completed.
b. Structures completed, but staff gauge not installed or painted.

c. Structures completed and staff guage painted, but markings not clear, so considerable margin of error likely, or

d. Structures completed and staff guage installed, but no regular readings and records made. This happens mainly due to shortage of personnel.

Almost all the measuring structures on the Silikkody branch canal fell in the second category at the time of our reconnaissance, though this may have been corrected subsequently.

Best records are maintained in the Uhana area, where there is reason to monitor off-takes very carefully at the head of the system to reduce water waste. Measurements are taken by ID personnel once a day and except for a few isolated locations, good records of discharge are maintained for canals of all levels.

In addition to the records maintained by the ID, field investigators of ARTI have measured water flows at about 80 different locations. Some of these measuring points coincide with those of the ID. Readings at these locations can be used to varify the accuracy of readings. Also, some of the ARTI readings are taken at drainage canals, which can be used in water balance studies. If there is one gap in the current measurement programme, it is the lack of attention to measurement of flows in drainage channels, which can give a pragmatic 'test' of the adequacy or excess of water deliveries at the head of D-channels and field channels.

Overall, the measurement capacity of the system has been impressively increased and the use of such capacity by the ID has been substantial. This has been plugged into computerized analysis of flows within the Left Bank system which has greatly

assisted water distribution. If the records on discharge that are now being maintained are continued, they will form a very good data base for future water management analysis and planning. The link to the mini-computer has substantially increased the efficiency of water distribution. However, the computer could be made more useful if more ID personnel are trained in using it. Such skills should be beneficial for the overall ID capacity for water management beyond Gal Oya.

Lessons Learned

Apart from assessments of capacity for conveynace, control and measurement of water which the physical rehabilitation component of the Gal Oya Water Management Project has created, and which is being reasonably well utilized now, there are some observations about the process of rehabilitation which derive from the involvement of ARTI staff and Cornell consultants with ID staff and PRC/ECI consultants over the six-year period, 1980 - 85. These cannot be rigorously 'proven' but we think they merit consideration for future efforts.

Rehabilitation is Different from Restoration: The initial conception of the rehabilitation to be done in GOLB was to restore the physical system to original design specifications. This was not possible because the latter could not be found. But it would have been undesirable even if possible because of many changes in the GOLB since original design and construction 30 years before. The actual command area had been expanded by over 50%, though no precise information on this was available (itself a shortcoming in the design process), while the water supply captured in the reservoir in most years had not met expectations. Population density had increased, as had subdivision of holdings. Much more was known about topographical, soil and hydrogeological conditions than 30 years before. All

these conditions should have created a precumption that modifications in design should at least be considered, not set aside with an operational commitment simply to 'restore' the system. The Gal Oya project has been very valuable for Sri Lanka by making this more evident than it was in 1978-79.

Rehabilitation should be More 'Pragmatic' than 'Systematic': Given limitations of manpower and finance, a thorough-going rehabilitation is not likely to be advisable, particularly since much of the effort as originally conceived was 'cosmetic', affecting appearances more than function. What is 'visible' (that is, above the water surface) is often less significant than what is not (what is below the surface). Particularly some of the initial 'rehabilitation' work which disturbed the banks of main and branch canals was not only of no value but proved actually deleterious as it increased siltation, given the characteristics of Gal Oya soils. To its credit, the ID came to the position of 'pragmatic' rehabilitation, following the axiom that what is not 'broken' need to be 'fixed'. Problem-identification and technical-cum-organizational solutions will be more cost-eefective than comprehensive planning and construction to modify (restore) all channels and structures.

The Role of Machinery Needs to be Carefully Assessed: In the initial stage of this project, to get it 'moving', the needs for machinery were hastilly assessed and decided, with large amounts of equipment ordered before any evaluation and planning of the actual task had been done. Among other things, this locked the construction strategy into a capital-intensive mode and precluded more labour-intensive and employment-generating approaches. The estimates of work to be done were themselves grossly off, by at least one-third (because incomplete listings of channel length were used, and drainage channels were completely ignored, though they were in dire need of rehabilitation). The

choice of machinery was also inappropriate in a number of respects, such as great excess rock-crushing capacity. It seems obvious now that a more careful approach should be taken to the acquisition and use of machinery.

The Sequence of Rehabilitation should not be Taken for Granted: The rehabilitation work was planned and implemented in what seemed to be a 'natural', indeed inevitable sequence, moving from head to tail. There was reason to repair and construct control and measurement structures in the head-end so as to enable the ID and water users to reduce water waste in that area, to conserve and convey it to water-short tail-end areas. But there were serious needs for conveyance and control structures in the latter areas, and particularly for desiltation work, not to mention amenities like bridges and bathing steps (which can help to preserve channel bunds as well as be convenient to the population). As so often happens, by starting work at the head, the tail end areas appear to have gotton less quantity and quality of rehabilitation work owing to the accelerating pressure of time to complete the work and the dwindling amount of remaining budget. We cannot advise on the technical considerations in sequencing rehabilitation work, but in discussing this question with the former Director of Irrigation after his retirement, Eng. A.J.P. Ponarajah, he stated that there was no technical reason why work had necessarily to prodeed head-first. We thus raise this question for further consideration because certain inequities and inefficiencies resulted from the head-first sequence.

There should be Coordinagion between Rehabilitation Design and Construction, on One Hand, and O&M on the Other: Although the rehabilitation design and construction was premised on a change-over from rotational deliveries to continuous flow, this was not communicated to the O&M branch of the ID so it could begin training of staff and communication with farmers to change

routines and schedules. This problem of disjunction between D&C and O&M is a worldwide phenomenon, not unique to Sri Lanka or the Gal Oya project. But in planning and carrying out rehabilitation, it seems special efforts should be made to minimize this gap, especially since D&C activities are likely to disrupt O&M in the short-run and then to have a long-run impact.

vi Quality of Construction Needs to be Safeguarded: Rehabilitation work is likely to be more scattered in concurrent locations and thus more difficult to supervise and to maintain quality standards. There are numerous complaints about sub-standard work made by water users which should be looked into. The problem appears to be much greater with work by private contractors than with that by the ID directly. At the outset of the project, the IE for construction suggested that it would make his job easier if farmers were involved systematically in monitoring and overseeing construction work, and even if their organizations were to undertake on contract much of the minor and scattered construction work. (If it was then sub-standard, they could be held more easily accountable, and they would have only themselves to blame). Unfortunately, no systematic opportunities were provided for a farmer role in monitoring or direct work, though the few instances in which farmer organizations were given contract work, the results were quite satisfactory. More clear-cut measures and policies are probably needed in future projects to ensure that government resources are used to their best effect and work is done so that it does not itself soon need rehabilitation.

vii Realistic Design Criteria are Important: Some standardized guidelines are needed for design and construction, but then there must be some willingness to vary and accommodate operations to compensate if designs to not quite fit a specific location. The specific example which we observed causing problems was the

Introducing Measurement Programmes should be Systematic:

When measuring devices are built and used, they should be carefully explained in advance to farmers so that no misunderstandings and resistances arise. Where possible, farmer participation and cooperaion in the measuring programme should be solicited. Since we found that sometimes small deviations from design in construction caused significant errors in the volume of flow, it is important that all structures and calibration be checked and varified. Also, a programme which concentrates only on measuring the volume of water issued, and which does not monitor drainage flows, will be more formalistic and less useful than it should be.

Conclusions

These are some of the observations about physical rehabilitation which stand out from our six-year association with the process in Gal Oya intended to assist the ID and IMD in their future efforts. It can be seen that most of these matters call for technical-cum-institutional approaches, involving management efforts by technical personnel and/or water users in addition to physical changes. There is indeed often some possibility for tradeoff, where systematic and sustained activities by technical personal and/or water users can substitute for expensive capital investments. It may be judged more reliable or more satisfactory to proceed with the latter, but we would suggest consideration be given to what extent institutional arrangements can reduce if not eliminate certain need for capital expenditure. An example would be a systematic programme of monitoring drainage channels rather than construct expensive field channel measuring devices. Another would be requiring farmers with direct pipe off takes from a D-Channel to join an adjacent field channel organization and to adhere to any schedule of rotational water offtakes it has rather than construct a new field channel which can be costly and will reduce cultivated area.

Chapter II

FARMER ORGANIZATIONS

As noted in the introduction, this component was not part of the initial consultants' design for the project, as the sociologist/institutional development member of the team attached most importance to improvements in the ID's main system management, regarding deficiencies in this regard as contributing to uncooperative and wasteful farmer behaviour, and fearing that efforts to get water user organizers would detract from this priority. In retrospect it is clear that there was scope for improvement in water management directly through farmer self-help methods, but also that farmer organization gave impetus through working with technical staff to making improvements in main system management.

The farmer organization activities were never a very large part of the project financially, involving about 05% of the project budget.. This was supplemented by USAID/Washington contributions of Cornell short-term consultants under the Rural Development Participation Project and then under Water Management Synthesis II Project, amounting to about $ 250,000. The total socio-economic component of the project which includes special studies as well as the farmer organization effort was less than 11% of the total.

Our evaluation of this component is more extensive and detailed, and in places more critical, because we have had more involvement with it than with other project components and because it is more clearly within our area of expertise.

Overview of Evaluation

Evaluation Objectives

In evaluating the Farmer Organization (FO) component, we look into the following:

1. The Institutional Organizer approach as a strategy for the promotion of Farmer Organizations (FOs);

2. The vitality of the FOs established in the project area and their capacity in contributing to various aspects of water management.

We also set out briefly the lessons learnt ffom our engagement in the programme which would be relevance to Farmer Organization programmes in the future.

Data Used for the Evaluation

The data for the evaluation were obtained from the following sources.

1. Results of a survey administering 250 questionnaires among farmers in the project area in November 1985.

The sample for this study was drawn from the record-keeping sample used by ARTI during the past 5 years for monitoring agricultural productivity, water availability, etc. It was considered useful to study the same sample from the point of view of Farmer Organization also in order to complete the picture. The ID request to confine ourselves to a rapid evaluation as much as possible using data already available with the ARTI was also responsible for the decision to use this sample. It would have been helpful to have drawn a sample from the Right Bank also as a control non-Farmer Organization area but the present disturbed conditions and the need to complete the evaluation rapidly were decisive here. Therefore in order to assess the impact of Farmer Organization, we have relied more on a comparison of data relating to "before" and "after"

FO situations. We have also analysed comparisons between areas with and without FOs as were covered within our sample.

2. Responses of 29 officers from the Departments of Irrigation, Agriculture, and Agrarian Services to questionnaires posted to them in November 1985.

3. Results of a survey administering 165 questionnaires among Farmer Representatives (FRs) in the Project Area in November 1985.

4. Data extracted from process documentation records collected by ARTI from 1981-1985.

5. Minutes of D-channel, Area Council and Project Committee Meetings.

6. Data from the Baseline Survey of the Project Area in 1980 by ARTI.

7. "Gal Oya Farmer Organization Programme: Progress and Prospects" by I. Ranasinghe Perera, ARTI, 1985.

8. Data from Mid-Term Impact Evaluation in 1983 by ARTI.

9. Professor Norman Uphoff's Trip Reports, 1981-1985.

10. Extensive discussions with farmer groups, farmers, Farmer Representatives, the IO Supervisor, past and present IOs, and officials from the Irrigation Department.

11. Discussions with the ARTI and Cornell staff involved in the FO Programme.

The Purpose and Objectives of the FO Programme

In the face of the heavy expenditure that has become necessary to rehabilitate the large irrigation systems in the country, it has been realised that the irrigation works constructed and

rehabilitated at such great expense cannot be maintained efficiently if their operation and maintenance are confined to the activities of the official sector alone. It is also realised that to make maximal and efficient use of these systems, it is necessary to develop better water management practices. Unless the users of the irrigation facilities, i.e. the farmers themselves, are somehow drawn into a commitment to look after and manage at least those sections of the irrigation facilities that directly serve them, it would be difficult not only to ensure the efficient utilization of the water made available but also to prevent the gradual decay and ruin of the facilities themselves.

To be more specific, an institutional mechanism is necessary which will

1. take on the responsibility of looking after the equitable distribution of water;
2. perform the task of avoiding or resolving conflicts which would otherwise be disruptive of the system;
3. promote among the farmers the knowledge and attitudes necessary for the conservation of water and the maintenance of the system;
4. ensure that the work of cleaning and maintaining the channels and structures within the FC area is done regularly and in time;
5. arrange to communicate the needs of the farmers to concerned agencies outside as well as to communicate among the farmers all relevant information from outsiders, e.g. the date of water issue of the field channels in the area.

Farmer organizations have been introduced to fulfil these objectives in he belief that the participatory approach which they embody is relatively more flexible, adaptive and self-sustaining. The objectives of the FOs in the GOLB area are therefore the promotion of the participatory approach with regard to water management and system maintenance at all stages from decision-making, including the identification of needs, to implementation including the enjoyment of benefits.

Current Status of Farmer Organizations in the Project Area

Brief History

The programme of forming Farmer Organizations commenced in March 1981 and has now fully covered an area of 25,000 acres, with 380 Field Channel Organizations (FCO) formed. The earliest farmer organizations were established in 1981 in the Uhana area and in parts of Gonagolla covering approximately 5000 acres. In 1982 a further area of 10,000 acres was organized in the Weeragoda area, and in 1983 parts of Uhana and Gonagolla were also brought under FO. By the end of 1983 the total area under FO was approximately 22,000 acres. In early 1983 it was planned to extend the programme into the Tamil-speaking areas of the GOLB namely, Mandur, Wellavelly and Silikkody covering an extent of 9,200 acres. But when 24 out of the 26 Institutional Organizers who were fielded in these areas left the programme to take up permanent teaching positions, no further progress was made. Continued unsettled conditions led eventually to the abandonment of the F.O. activities in the Tamil-speaking areas. In 1984, additional parts of Gonagolla and in 1985 head-end areas of Paragahakele were organized. The expansion of the programme is shown in Figure 1.

Apart form the 380 Field Channel Organizations, 29 D-channel Organizations and 4 Area Councils and 2 Sub-Area Councils have

been formed. As indicated in Table 1, 13 more D-Channel Organizations (DCO) are planned to be formed (6 in Gonagolla and 7 in Paragahakéle). The 3-tiered FO structure formed thus of FCO, DCO and Area Councils was capped by the formation in June 1985 of the GOLB Project Level Committee as a fourth tier. Farmer representation in the District Agricultural Committee since 1982 had constituted a defacto fourth tier. Statistics on the first three Area Councils are given in Tables A1, A2 and A3 at the end of the report (see Annex I).

Structure and Organization

Field Channel Organizations are small groups of usually 10-15 farmers cultivating with water from a common channel. Their objective is to promote co-operation for water management activities as well as to develop among the farmers attitudes conducive to participation in system management. These Field Channel Organizations are informal in nature and might best be thought of as groups (kandayam). They have no regular schedule of meetings. They meet if and when there is a need, though especially in advance of each season. Each organization selects by consensus a Farmer Representative (FR) who is responsible for co-ordinating the activities of the Field Channel Organization. In field channels where the number of farmers exceeds 15 to 20, there is usually a second FR selected, and in cases where the number is more than 30 to 40, a third FR is usually selected, as the field channel may be divided into several sections for purposes of intensive management.

D-Channel Organizations have as their members the FRs of the Field Channel Organizations which are served by the particular D-Channel. However, where several D-Channels are short or where more than one D-Channel are so located that the fields fed by them form one hydrological unit, they have usually joined together under a single organization. On the other hand, where

Table 1 : Current Status of F.O.s as at 30th November 1985

Area	No. of F.O.s	No. of F. Reps.	No. of DCOs Formed	No. of DCOs to be formed	Extent covered Area	No. of Farmers	Area Councils
Hhana	95	122	8	-	5064	1976	1
Gonagolla	135	162	11	6	7410	2273	3
Weeragoda	108	135	8	-	10173	2709	1
Paragahakele	42	48	1	7	2600	980	1
Total	380	467	29	13	25247	7938	6

excessive length or hydrological considerations make it appropriate, more than one DCO may be formed for a single D-Channel, e.g. on M-5 in the Weeragoda area. Since hydrologically M 5.1 and M 5.2 are similar and differ from the other, 2 DCOs have been formed, one for M 5.1 and M 5.2, and the second for the others. These decisions have been made entirely by the farmers. As a result, the extents covered by each D-Channel varies from 100 acres (UB 8 + 8a) to 1560 acres (M 5.3, 5.4, 5.5, 5.6, 5.7 and 5.8) (see Tables A1, A2 and A3 for details).

DCOs have as their members all members of the FCOs under them. FRs or others selected for the purpose represent these FCO in the Committee of the DCO. From among the members of the Committee, the President, Secretary, Treasurer and office-bearers are elected. Compared to FCO the DCO is more formal and each DCO has a written constitution. They are expected to meet once a month and members who are absent without leave at two consecutive meetings may be required to explain in writing. If no satisfactory explanation is forthcoming, the FCO may be requested to send some other person as its representative.

Since, DCOs have all been devised by the farmers themselves and not determined by any master plan, they vary in their stated objectives as well as in other features. For instance, some admit one FR from each FCO while others permit more; some stipulate that only a FR may represent and FCO whereas others permit any farmer to be sent as a representative; some DCOs allow all water users including 'drainage farmers' to become members of the general body while others restrict membership in the general body to the authorized water users only.

Area Councils

The four main areas of the GOLB, namely, Uhana, Weeragoda, Gonagolla and Paragahakele are served by Area Councils

Gonagolla, being the most extensive and thus involving larger distances, is served by one Area Council and two Sub-Area Councils while each of the others is served by one Area Council. All the farmer representatives from the FCOs in the area are members of the respective Area Councils and attend meetings of the general body or 'Maha Sabha Rasveema' as they are called. Buththese general meetings are held only when important decisions have to be considered. Otherwise, the regular monthly meetings are attended only by the members of the Working Committee which consists of the principal office bearers, i.e. the President, Secretary and Treasurer of all the DCOs in the area. Exceptions are the Gonagolla and Paragahakele Area Councils which being of recent origin have so far held only general meetings. But the three Gonagolla Area Councils are soon to have one Working Committee with the office bearers from all the DCOs in the Gonagolla area.

Area Councils are formally constituted and have written Constitutions. Their objectives are stated in very broad terms. For instance, the Weeragoda Area Council states its objectives as follows:

1. to work for the social, cultural and educational upliftment of the people of hê area;
2. to provide a linkage between the farmers and the relevant Government agencies;
3. to participate in the maintenance of that part of the GOLB system which falls within its area;
4. to scrutinize critically district-level decisions as and when they affect the area and to feed back responses to the farmers on the one hand and to the relevant agencies on the other;
5. to serve as a link to maintain the cohesion of the various levels of farmer organizations in the whole area.

Office bearers of the Area Council are elected at the Annual General Meeting of the whole body of membership. Area Councils also meet onee a month and these meetings follow the D-Channel Meetings to enable Area Councils to consider decisions and difficulties arising from the D-Channel Meetings.

The Project-Level Committee

In June,1985, the Gal Oya Valley Farmer Organization Project-Level Committee was formed with 10 representatives from the Area Councils. The different areas are allocated representation according to the size of their membership - Uhana 3, Gonagolla 3, Weeragoda 2 and Paragahakele 2. The Government Agent, Ampara District and the D.D.I. Ampara have been invited to be the Chairman and Secretary repectively with one of the FRs serving as Joint Secretary. The District-Level heads of all the relevant Departments in Ampara including the G.A. and the DDI are also membefs of the Committee. Thus the Committee has a total participation of 10-20 officials and 10 FRs.

The objectives of the Project Committee are stated as follows:

i to improve water management in the GOLB;
ii to solve problems which cannot be resolved by farmers and officials at the lower levels;
iii to have farmer participation at policy-making levels;
iv to protect and supervise the operation and maintenance of the irrigation system in the GOLB.

The Committee is expected to meet once every three months and always ahead of Kanna Meetings. It is also proposed by the farmer members that since the Project Committee is to meet only once in three months, it may be useful for the farmer members

to have discussions among themselves regarding the matters that come up from the monthly meetings of the Area Council and other current issued. These meetings can be convened by the Joint Secretary. The first Project Committee meeting was held on 18th of June 1985 and a farmers Sub-Committee meeting was held soon after. There were no meetings until again in January 1986 because of a change in the DDI Ampara who was not familiar with his role as Secretary to call the meeting.

Meetings Attendance, and Matters Discussed

Field Channel Organizations

The Field Channel FO meetings are not meant to be formal gatherings and do not maintain redords of minutes of discussion and decisions taken at their meetings, But the extensive Process Documentation carried out by the IOs provides some information regarding the nature of the subjects discussed in these meetings. Originally the FCO were the only organizations available to the farmers and all farmer problems were discussed at their meetings. Internal issues such as water rotation within the field channel, channel cleaning, cattle damage, etc. as well as difficulties which require contact with officials or agencies outside the field channel such as rehabilitation matters, water shortage, damage to structures, etc., were all discussed at FCO meetings. But with the emergence of Area Councils and DCOs the concern of the FCO has become largely confined to the internal problems such as channel cleaning, and water distribution. As a consequence there seems to be less need now for these meetings. But,,on the other hand, the FR has by his capacity to represent farmer problems at more effective forums such as the DCOs and the Area Councils assumed an even greater importance, so much so that there is a general pattern noticeable of Field Channel Organizations tend now to have a greater number of FRs. than before; where an FCO had

one representative before it is now found to have two or even three. Farmers explain this development by pointing to the specificity of the nature of the problems faced by the farmers at the head, middle and tail ends of the field channel and the need to speak up for them. This is also due to the desire among the farmers to be more actively represented and 'linked'.

52% of the farmers who repponded to our questionnaire said the Field Channel Organizations previously used to meet "many times" during the season, while 30% said that they met once every season and 9% said that they met "regularly". (see Table 2 below). In response to our question about the situation now, 56% responded that they meet only once every season while 7% said that they met regularly, and 28% said that they meet many times during the season.

This trend of a decline in the frequency of FCO meetings was also observed by us during our field trips. But it would be hasty to judge that this change in the frequency of meetings is a symptom of a decline of interest in farmer organizations themselves. The farmer organizations are fairly small groups and the ratio of FRs to farmers almost never exceeds 1:15. All the members live and work very close to each other and there is reasonably easy access among the farmers including the FR who is also one of them. The problems which require common action are rarely novel and the FR becomes aware of any new development without any serious time lag. Difficulties or problems faced by individuals can of course be brought to the attention of the FR without summoning meetings of the organization as a whole. As should be evident from Table 2 there is an agreement that the FCOs always meet before the Kanna meeting held each season to discuss matters related to channel cleaning, date of water issue, nature of water rotation etc.

The difference in the frequency of the FCO meetings between the earlier years and now, can be attributed to another development, namely, the formation of the DCO and the Area Councils. Some of the problems which in the absence of these larger organizations were discussed at the FCO meetings, probably not to much avail, are now more appropriately taken up at DCO and Area Council Meetings. For example, water rotation arrangements which were earlier discussed at the FCO, which was the only available organization, are now discussed more appropriately at DCO levels. Farmers find the Area Council a stronger forum to discuss problems relating to the procurement of inputs and the marketing of produce. Where the farmer grievances require attention from the ID or some other Government department, e.g. the need to repair a damaged bund, the farmers realize that it is more effective to direct their requirements through more broad-based and therefore stronger organizations.

Table 2 : Frequency of Field Channel Meetings

	Early Phase of FO	Now
Never	01	01
Once a year	03	07
Once a season	30	56
Many times a season	52	28
Once a month	05	01
Regularly	09	07

(N = 111)

The minutes of D-Channel Meetings show that farmer grievances arising from field channel groups but needing intervention by other agencies are often discussed at these D-Channel Meetings. Farmer problems therefore are certainly being communicated to FRs, and FRs and FRs are fulfilling their duties by representing matters at more effective forums. This is confirmed by the

respondent s to our questionnaire regarding the quality of FRs where 89% of the farmers expressed their confidence that their representatives are responsible persons. Ninety-three percent of the respondents to another question judged their ERs as persons "acceptable to all or most" of the farmers in their field channel groups. When farmers were questioned whether their representatives were arranging sufficient number of meetings, 73% of the respondents said that the number of meetings arranged was sufficient for the purpose while another 3% felt that the number of meetings were even more than sufficient. This puts in context the reported decline in the frequency of FCO meetings reported in Table 2.

It seems therefore that farmers are satisfied with the manner in which their organization functions despite what may appear as a lower frequency of meetings. The strength or weakness of FCO in its capacity to deliver the goods expected of it by the farmer members does not seem to be dependent on frequent formal gatherings. The availability of easy informal contacts and the shared knowledge of common problems seem to make frequent formal meetings unnecessary.

Since the meetings are informal there are no proper records of farmer attendance at the FCO meetings. Documentation records show about 80% attendance at the meetings for which data are available. Responses to our questionnaire also indicate that nearly 60% of the farmers attend all or most meetings while 88% (Table 3) of the farmers have attended at least a few meetings and more than one meeting. Considering that according to 56% of the respondents, the FCO have held only 2 meetings for the year it would appear that the level of attendance at the FO meetings is very high.

Table 3 : Farmer Attendance at Field Channel Meetings

	%
Never	07
Once a year	05
A few meetings	30
Most meetings	37
All meetings	21

D-Channel Organizations

When our questionnaire was administered in November 1985, 29 out of the projected 42 D-Channel-level organizations had already been established (69 per cent). Of the farmers questioned, 63% were aware of their existence. The first of these D-Channel organizations was formed in 82 May in Uhana and by December 1984, altogether 17 D-Channel organizations had started functioning in the Uhana and Weeragoda areas. 12 D-Channel organizations were formed in the Gonagolla and Paragahakele areas during the course of 1985.

D-Channel level farmer organizations are expected to meet once a month. But a survey of 6 organizations selected at random from the 29 which had been formed up to November 1985 shows that as a matter of fact hardly any of the D-channel organization meets as frequently as required in their Constitution.

Out of the 6 studied, only 2 (both of which had been formed in 1985) had held one meeting for every month of their existence. Another which had been in existence for 31 months had until November 1985 held only 8 meetings (see Table A4). Attendance at the meetings which were held, however, has been very high. Three of the organizations recorded on overall attendance of over 90%, 2 over 80% and the lowest recorded was 78%. Records of the meetings also show attendance by ID officials of various

grades ranging from DDI Amparai to Irrigators and Work Supervisors. Officials from the Agrarian Services Department as well as the Department of Agriculture have also attended these meetings.

In general it appears that the matters taken up for consideration at the Distributary Channel Farmer Organizations are determined by the relatively greater effectiveness of these organization when compared with the field channel level organizations. One of the main subjects discussed in all DCO meetings so far has been that of rehabilitation and the deficiencies perceived by the users of the system. Though the ID has in most cases gone through the exercise of consulting the field channel organizations with regard to rehabilitation work, there has been widespread dissatisfaction with the results. Most farmers complain that many of their suggestions have not been incorporated in the final design despite even explicit approval of these suggestions at the time when they were made. Farmers therefore feel the need to reiterate their ideas to ID officials and it is more practicable to bring these up at a higher level forum such as the DCO than at the ECO.

Minutes of the DCO meetings showed that at the meetings of all DCOs, FRs have presented lists of deficiencies they have perceived in rehabilitation work done in their respective channels. And on most occasions the IEs have agreed to do what is possible and the DD/I. Amparai has inspected the entire rehabilitation site in order to assess for himself the suggestion of the farmers. Changes and improvements have been made whenever possible and are continuing to be made. It would have been impossible for the farmers grievances to have been communicated to the IEs or the DD/I if a forum such as the DCO was not available. For it would have been very difficult for the ID officials to discuss grievances one again with the farmers at each of the numerous field channels. And in those areas where

rehabilitation has not yet begun, the farmers have through the DCO given a list of ordered priorities to enable the ID to do as useful a job as possible within their/fianancial constraints.

All DCOs meet at least before the Kanna Meeting for each season and decisions are taken , on the basis of suggestions from the FCO conveyed by the FRs in order to present farmers' requirements at the Kanna Meeting. Thus the DCO serves as a forum where the farmers would organize themselves to present a common plan and to speak with one voice at the Kanna Meeting. This has had the effect of transforming the farmers from being passive receipients of decisions handed out to them by ID and Kachcheri officials into confident spokesmen and participants at Kanna Meetings.

Water rotation arrangements, whereever necessary, are discussed at DCO meetings and this of course is the more suitable place to discuss this matter than FCO meetings for the reason that more than one FCO is involved. Though the ID has given the general rule that the field channels will have to practice water rotation, the actual details have to be worked out, taking into account the requirements of each field channel. Also arrangements have to be made with the Jalapalakas to see that they are available to open and close the gates according to the schedule of rotation decided. All this is done now at DCO meetings. The problem of doing earth work which was assigned to the farmers in each field channel was another topic considered at DCO meetings. There are many field channels which are too long for the earth work to be done unaided by the farmers and the possibility of getting ID assistance was often considered. DCO meetings also discuss the possibility of establishing funds to serve such purposes as building up credit facilities for farmers, purchase of inputs, etc,, as well as for the expenses connected with the administration and

maintenance of the farmer organizations themselves. It was decided in most DCO meetings to collect five rupees each from farmers and to allocate the amount collected among FCO, DCO and Area Councils to cover travelling and other expenses.

FRs also bring to DCO meetings problems created by delinquent or uncooperative farmers in their field channels and common strategies are discussed. The vexing question of reservation farming is another matter that is often brought up at DCO meetings.

72% of the farmers feel that the working of the DCO strengthens the capacity of FCO. The respondents explain that FCOs vary in strength and the weaker ones are benefitted by the feed back from DCO meetings and decisions, Most of the farmers (64%) were satisfied that they - the farmers at the grass roots - were kept informed of the decisions made at DCO meetings.

Area Council

As mentioned already under the section on structure and organization, meetings of the Area Councils are of two types - the "Maha Sabha Rasweema" or meetings of the general body which are convened occasionally and the more regular monthly meetings of the Working Committee. In Weeragoda, Gonagolla and Paragahakele, the are council meetings have been held regularly every month since their inception. But in Uhana, meetings have been less frequent. The Area Councils in Uhana was formed in January 1984 and it has had up to December 1985 held 12 meetings, i.e. one meeting for every 2 months. In Weeragoda for which alone we have figures for meetings of the general body, there have been 6 such meetings in 1984 and 5 meetings in 1985 besides the monthly meetings. The main reason for convening meetings of the general body seems to be to consider

such questions as fund raising or to consider large-scale calamities as after a severe drought or damage due to floods. When a proposal to raise funds by subscription from the farmers is approved by the general body, it is usually referred down to the DCO and the FCO for concurrence and implementation.

The Working Committee Meetings consider broad questions such as the price of paddym marketing facilities, the availability of inputs for the farmers of the area. One meeting of the Area Council considered, e.g. whether the Paddy Marketing Board may be requested to return to the farmers the gunny bags in which their paddy was delivered to the Board. At another meeting it was decided to point out to the CroppInsurance Agency that inspection of damaged crops should be done in the presence of the farmers in order to ensure fair assessment. The persistent neglect of the ID to grant contracts connected with rehabilitation to the farmer organization which have registered themselves for this purpose with the ID was the subject discussed at another meeting. Pensions for farmers, life insurance and farmer identity cards, were some other matters considered. At meetings held immediately before Kanna Meetings, more urgent matters such as water rotation etc. were also considered by Area Council Committees.

Project Level Committee

It has been mentioned that as of December 1985, only one PLC Meeting had been held and that the Committee as a whole has not met since its first meeting in June 1985, The matters which were discussed were as follows:

i the distribution of seed paddy was taken up and the Assistant Director, Department of Agriculture undertook to see that there was a sufficient and well-organized supply of seed paddy for Yala 1985 sowing.

ii the Assistant Commissioner, Co-operative Development brought up a proposal for the intensive cultivation of chillies in Weeragoda with a view to export.

iii the progress of rehabilitation was discussed and the farmers were informed that the work would continue and many of the areas where it was not done yet, would see their completion in 1986.

Farmer Perception of Water Problems

Data gathered among farmers shown change for the better in their perceptions of water problems in the GOLB. area. For instance, while only 13% of the farmers in the Baseline study reported that they had no problems during Maha, in Maha 1984/85, 45% said that there was no problem. But for flooding in that season this percentage would probably have been much higher. There was a very significant drop in the percentage of persons reporting shortage of water for Maha - from 55% to 22% (Table A5). The improvement is even more pronounced in the figures for Yala. In the Baseline study, only 3% reported no problem while now 56% say that they had no water problem in 85 Yala. Shortage of water was reported in the Baseline study by 73% while now only 22% mention shortage. (Table A6). But with regard to the reliability of water supply for a minority there seems hardly any change.

The mid-term study asked farmers whether the respondents themselves had suffered water shortage during 1981 Yala seasons. The Table 4 gives the figures obtained then as well as those obtained now in response to the same question. While there was little difference between 1981 and 1982, there is now a definite drop.

Table 4 : Farmers Reporting Severe Water Shortage

Season	Percent of respondent reporting for
Yala 1981	29 (N = 168)
Yala 1982	31 (N = 169)
Yala 1985	18 (N = 191)

The baseline survey also gets farmers' views on the reasons for their water problems. 32% of the farmers thought that inequitable distribution of water was the case while 22% of the farmers mentioned stealing of water by other farmers on their FC as a contributary factor. (see Table A7). In the responses from farmers in the final evaluation survey, only 15% attributed their water problems to inequity in water distribution while only 4% complained of stealing of water. Farmers are also less inclined to blame their misfortunes with regard to water on officers' ignorance or neglect, down from 22% to 6%. In the eyes of the farmers poor channel maintenance and damaged structures also contribute less now than before to water problem.

If there is water shortage now, farmers seem to perceive it as being due also to non-availability of water in the system or at least as not being due to the officer neglect or farmer irresponsibility. There is thus progress towards more rational understanding of their circumstances. Natural conditions are seen for what they are instead of being though of as a product of the evil nature of others.

The Baseline Survey reported that only 2% of the 475 sample farmers answered 'No' to the question whether head-enders take too much water. In the mid-term study, 41% claimed that there was over-use of water by head-enders. Though the same question was not asked in our survey, our sample of 194 farmers made up

[illegible] head, middle and tail, was asked whether [illegible] s took more water than necessary and only [illegible] wered this question in the affirmative. [illegible] re not strictly comparable, it seems th[illegible] cy noted in the mid-term study has der[illegible] d that farmer practices towards water conser[illegible] ve impr[illegible]ed.

Farmer O[illegible]ion and Water Management

Ultimately the best indicators of progress in water management in the GOLB would be the extent to which, other things being equal, water is made available for cultivation of additional lands and tail-end lands which were earlier abandoned due to lack of water are now restored once again for cultivation. But two factors, namely, the abundant rains of the last two years and the improvement in water conveyance due to the physical rehabilitation of the system, make it difficult to assess the improvement attributable to better water management by farmers alone. We must rely here, therefore, on the judgements of farmers, Farmer Representatives, IOs and other concerned officials for signs of improvement in farmer behaviour, knowledge and attitudes with regard to water management.

Water Distribution; Water Rotation

The principal objective of the FGs in water management is to promote equitable distribution of water while at the same time ensuring that the water is used efficiently and without waste. The chief method adopted to ensure equitable and efficient utilization of water has been rotation of water within and among field channels.

In the GOLB area, water rotation was given a great deal of impetus with the formation of FOs. Most of the rotation systems adopted are simple ones according to which the field channel is divided into upper and lower sections or into upper lower and middle sections. Water is delivered to each section alternatively and in some field channels the lower sections are given water first and the others later. This ensures that the tail enders get water with a flow is strong enough to reach them. The benefits of water rotation were one of thechief advantages noticed by farmers in the innovation effected by farmer organizations. Thus, Ranasinghe Perera reports; "Farmers were able to save much of their crop during water shortages during the Yala 1981 season due mainly to water rotations and water management programmes. Because of these benefits, the farmers themselves requested the officers at the Yala 1982 Kanna Meeting at Weeragoda programme". Professor Uphoff's trip reports give other instances of benefits gained through the promotion of water rotation doen by FOs, e.g.

i The adoption of water rotation among field channels in M5 area enabled farmers to cultivate over 700 acres previously abandoned due to inadequate water.

ii On the tail end of M 5.4, many acres of fields could not be cultivated earlier. In Yala 1984, after farmers excavated channel lengths by Shramadana, water rotation permitted cultivation of an additional 14 acres.

iii On UB 17, 40 acres were brought back into cultivation during Yala 1984 through water rotations.

Our survey of FRs showed that adoption of rotations on field channels had led to an increase of land cultivated by 832 acres. Since our sample covered only one-third of Farmer

Representatives, one can estimate that about 2,500 acres may have been added to cultivable area, with or without physical rehabilitation. In so far as this enhanced water control capacity and therefore also supply, some of this previously uncultivated area might have forgotton restored to cultivation by rehabilitation even without farmers understaking rotation, however, This bears out the earlier difficulty we alluded to in separating out the effects of farmer organization.

In our survey, 51% of respondents said that their FOs practised water rotation during Yala 1985. This may appear to be a disappointing level in the adoption of rotation, but it reflects only the level in a relatively water-abundant year. This level was reportedly higher in previous years where FOs had been set up. The USAID evaluation team took a negative view of this level in its report, attributing a decline to two factors,,the abundance of rains during the last two years, and disincentives some farmers might feel to maintain a water rotation if some fields are having direct access to D-Channel water.

Our understanding of this issue is that farmers have now successfully carried out rotations in 70-80% of channels when there was need, so that this level represents the capacity which has been created. There is no reason to expect or require farmers to invest the extra labour required for rotation if water is not a constraining factor of production. In fact, farmers registered rather favourable assessments of water rotation in our survey. Farmers have grasped that water rotation is beneficial not only to themselves but also to the others who are not so fortunately placed. 98% per cent of our respondents agreed that water rotation leads to greater equity in water distribution and 79 per cent of the farmers agreed that they would themselves be assured of adequate water under water rotation.

When the head and middle end farmers face less plentiful supplies of water it can be expected that they will be prepared to adopting more economical methods of water distribution.

Water Conservation and Water Waste

Farmer Organizations also seek to improve water management by promoting among the farmers greater understanding of the water requirements of their fields, as well as by fostering a greater concern for the needs of those who are less fortunately placed below them in the channel.

Farmers were questioned about the prevalence of wasteful water use in their areas, and 88 per cent of the farmers from field channels where there are FOs said that the extent of wastage is now definitely less or non-existent. Only 18 percent of the farmers in such areas reported that there were still farmers who tended to take more water than was necessary for their fields. When questioned about the reason why they thought there was less wastefulness, now their replies were very revealing and differedvery significantly from those given by the farmers in areas wher there are no FOs. 50 percent of the farmers from FO afeas attrituted the improved management to the farmer' understanding of the needs of the other farmers and to the realization that excessive intake of water was not of much use for better yield (Table 48). Only 11% of the farmers in FO areas thought that strict controls by the ID had anything to do with improved farmer behabiour. In channels where there are no FOs on the other hand, 49% of the farmers explained any improvement in farmers' practices to such external controls; 8% instead of all attributed to changes in attitude or understanding. Farmers were also asked to give their estimate of the percentage of farmers who would take the trouble to close the poles to their fields when sufficient water had flown in. In FO areas, 69% of the farmers said that more than 75% of the

farmers in their FO could close their poles while in non-FO areas only 22% had that confidence. In non-FO areas, 62% felt that no one would bother to close the pole on his own initiative, while in the FO areas, only 4% had such fears (Table A9).

Farmers' attitudes towards the saving of water and concern for other users of water also is seen to be dramatically related to the activities of farmer organization. 78% of the farmers from FO areas said that they were concerned to save water for the benefit of the farmers below while in non-FO areas, only 12% of the farmers admitted to having any such concern. (Table A10). The farmers also perceived that there had been a definite improvement in their own attitudes. Only 5% of the farmers felt that they had had any concern for the farmers below them before the advent of FO and 63% of them were definite that they had no such concern then. Farmers were asked as to why they were not concerned earlier with the needs of the farmers below. A majority felt that they were then not accustomed to think in those terms and that they were therefore only interested in getting as much water as possible whenever the 'getting was good' particularly in view of the chronic unreliability of the water supply.

It should therefore be pointed out that the responses of farmers reveal that improved attitudes and behaviour with regard to water use are influenced by reliable system performance as well as on enlightened farmer attitudes. Farmers themselves do not appear to place such great importance for this factor as an explanation of behavioural change as seen from Table A12.

Damage to Structures

Farmer interference with channel gates and other structures in order to gain immediate advantage to oneself has been one of the most vexing problems in the GOLB as it probably is in other

schemes too. These surreptitious and selfish interferences are damaging to the structures and lead eventually to a rapid deterioration of the system. The promotion of more responsible attitudes towards such damaging practices was therefore one of the prime purposes for the formation of the FO from the point of view of the rehabilitation effort. The responses obtained from the farmers we questioned on this point are encouraging. 77% of farmers reported that there is no damage now in the FC areas and 81% said that the extent of damage had declined. This may be compared with the perceptions of 63% of the same farmers that before the FO there was widespread damage in all their FCs (Table A11).

75% of the 158 FRs interviewed said that there has been a decrease in the extent of damage to structures by farmers and explained this improvement in terms of the improvement in the knowledge and attitudes of the farmers after the formation of FOs. Ther farmers now had a sense of collective responsibility for the FC and its structures according to the FRs. They also had an improved understanding of the functioning of the structures. There was now a greater understanding between the farmers themselves. The FOs had also promoted among the farmers a healthier attitude towards the ID. Attendance at design meetings had also increased the farmers' awareness of the undesirability of damaging structures (see Table A12).

Conflicts and Conflict Resolution

Conflicts arising during water distribution were rampant among the farmers in the GOLB area. Inadequate and unreliable water supply, damaged control structures, ignorance or lack of confidence in water rotation, etc., were all factors which contributed to the frequency of conflicts among the farmers. One of the consequences of the formation of FOs is the greater understanding achieved among farmers and the possibility now

of resolving difficult situations before they degenerate into serious conflict. 153 of the 158 FRs who responded to our questionnaire on the subject, said that there was a decline in the number of water-related conflicts in their FC areas.

Table 5 : Did You Encounter any Conflicts over Water Distribution in Your Field Channel during Maha and Yala 1985?

	% Responses
None	77
0 - 5	18
6 - 10	20
10	0

(N = 164)

12% of the FRs attributed the reduction in the level of conflicts to such factors as improved conditions of field channels and structures due to better cleaning and rehabilitation. But more of them (69%) attributed this to changes in farmer attitudes and to the harmony and understanding that have emerged among farmers due to the FOs.

The FRs were also invited to quantify the number of water-related conflicts they had come across in their FCO during Maha and Yala 1985. The responses are given in the Table 5.

It would be noticed that 77? are able to report that there was none and that none could report anything mor than a total of 10 conflicts for the two seasons.

When farmers were asked about the effect of FO on the prevalence of water related conflicts, 85% of the farmers felt that the number of conflicts had declined while there were none who felt that conflicts were in the increase. Only 3% of the farmers felt that there was no change (see Table 6).

When farmers were questioned about their own involvement in water related conflicts 73% of the farmers recalled that they themselves had been parties to water related conflicts before the FOs. Only 9% of them said that they were involved in such conflicts after FO.

Table 6 : Prevalence of Water Related Conflicts
(% reporting personal involvement in conflicts)

	Before FO	After FO
1. Yes	73	09
2. No	27	91
	(N = 197)	(N = 110)

As observed in the mid-term evaluation, while this comparison is not quite fair as the period before FOs is longer than the period after, it is still indicative of a strong tendency towards decline in the frequency of conflicts. Our survey among FRs supported very strongly the presence of this tendency. Of the 164 FRs who responded, only 28 said that they encountered conflicts in their respective field channels in 1985 Yala. When they were questioned about the means by which these conflicts were resolved only 9 cases were reported as having been referred to ID or any other agency outside the field channel. No case, according to these FRs, was taken to the police. The bulk of the cases to have been settled through the FO by arbitration by the FR or by understanding arrived at by the farmers themselves. That the FO are beginning to play a more prominent role in conflict resolution was indicated already in the course of the mid-term study. The data showed then that the majority of the conflicts were being sorted out either by the FO or by the IOs and that there was a very significant reduction in the cases being taken to other agencies outside, such as the police. The data gathered among farmers

confirm that in areas where there are FOs the FO and the FR play a very important role in conflict solution (see Table A13).

Channel Clearing

Farmers are expected to participate in system maintenance at the field channel level by keeping the channels clean and in good repair. Channel cleaning is the more important part of the farmers' responsibility in this respect, in the sense that it needs to be done regularly, i.e. at least twice a year. The ability of the system to deliver water to the fields, ultimately depends on the field channels being maintained in good order. Equally important are the drainage channels though these tend to get neglected by most farmers.

Our questionnaire responses indicate very significant differences in the level of channel cleaning according to farmers' perception of the situation before and after the advent of FOs. 81% of the farmers said that channel cleaning in their FCs was poor or very poor before the FCs were established. (see Table 14). But now only 6% felt that still there was poor channel clearing. 65% of the farmers feel that now the channels are in good or very good condition whereas only 7% are willing to say that they were so even before the FOs. The farmers' estimate of the present level of channel maintenance was corroborated by the responses from FRs. 94% of whom reported that channel maintenance was being done regularly. And of the 156 FRs who responded 96% said that less than 5% of the farmers in their field channels neglected to clean their share of the field channels. Only 4% of the FRs estimated that those who neglected field channel cleaning may amount to as much as 10%. As for the quality of the cleaning work, 84% of FRs said that the quality was good, 12% said that it was fair, while 4% complained that it was poor.

There is one point however to be noticed here which may be of some significance. At the outset, the farmer organization encouraged channel cleaning on a collective basis through Shramadana. The mid term study showed that in 82/83 Maha for instance, only 27% of the channel cleaning was done by individuals while the rest was done, either entirely or partially, collectively. In Yala 1982 and 1983 also the situation was more or less the same while before the FO bearly 80% of the channel cleaning was done individually. But now it appears that there is a return to the practice of farmers confining themselves to their individual allotments. (see Table A15). Though the numbers reporting Shramadana style collective work is still higher in FO areas than in non-FO areas collective work was reported by only 26% farmers. But the shift from Shramadana to individual clearing was apparently had no effect either on the extent or quality of channel clearing for out data reported elsewhere indicates very clearly that these remain high.

In places where there are FOs the channel cleaning is of course supervised now by the FR instead of the Yayapalaka who in most places had done this work earlier, as indicated by Table A16.

Officer's Perceptions of FO Impact on Water Management

Though we sent questionnaires to 60 officers regarding the impact of FO on water management, we received responses only from 30 officers, made up as follows: Irrigation Engineers 5, Technical Assistants 3, Irrigators (Jalapalakas) 3, Work Supervisors 4, Cultivation Officers 6, Divisional Officers 2, KVS 4, Agricultural Instructors 3. 70% of the officers interviewed said that FOs have contributed towards improved water management. It is also observable from Table A17 that 70% of the officers feel that FOs have succeeded in bringing

about equitable distribution of water among farmers. Officers including the former DDI Ampara who perhaps, among the ID officials has spent the most amount of time watching FO work, explains this improvement by pointing to the difference between FOs and other institutions which have hitherto been responsible for water distribution. The FR unlike many of the Yayapalakas or even the Irrigators, is not motivated by selfish or partism considerations.

But the officials are however not as enthusiastic when asked to comment on channel clearing (Table A18) or water saving. 40% of the officers, these were mostly from the ID, were emphatic that it is not true that farmers waste less water now. The former DDI in trying to explain this situation has said that in areas where the FO are strong there is definitely less wastage of water, while this improvement has not been achieved in areas where the FOs are weak. But relatively the situation is definitely better now. The trend with regard to damage to structures and channel cleaning is however not equally impressive, though majority of officers think that there is an improvement in this respect also as could be seen from Tables A17 and A18.

Farmer Participation in Construction Stage

Rehabilitation and Design Meetings

It was realized fairly early that it would be mutually more beneficial if the activity or organizing the farmers and the work of rehabilitating the physical structures was coupled instead of being done in isolation from each other. The rehabilitation itself would be of a better quality if the needs, perceptions and the experience of the farmers could be communicated in time to the designers. The participation by farmers brings the further benefit of giving them a sense of

ownership and thus a more profound stake in the subsequent maintenance of the structures they themselves had helped to design, as it were. These design meetings could also serve on occasions to explain to farmers the purposes and functions of the structures so that the farmers will take greater care not to damage or destroy them at the first sign of failure or malfunction.

From the point of view of FOs, it was realized that farmers could learn the benefit of participation and acquire participatory attitudes only by becoming directly engaged in participatory activities. Taking paft in design meetings was then an opportunity not to be missed in launching the whole programme of farmer organization.

Design meetings with farmer participation were held from mid-1981 i.e. following the fielding of the first barch of IOs. A year later the format of these meetings was amended in order to save time, and a form was evolved called 'walking the channel': the IE and his staff assembled at the head of field channel and by pre-arrangement the farmers in the channel joined them to work the length of the channel. In the course of the walk the farmers pointed out all their problems and needs which they wished dealt with in the design for the rehabilitation of the channel. This proved very effective, the Engineers learnt very soon to respect and rely on the farmers' detailed knowledge, gathered through thirty years of working, benefiting and suffering with the idiosyncracies of their field channel and its structures. The farmers supplied them with information about field channel conditions, the lay of the land, the length, position and effectiveness of poles, etc. which the Engineers would have been hard put to gather if left to themselves.

All Engineers and Technical Assistants whom we interviewed said that the design meetings were very useful to them and that the farmers were able to give them information which would

have otherwise taken them an impossibly long time to gather. The following were only a few of the instances to illustrate how designing benefitted from farmer participation.

i Location and size of pipe outlets of fields, In one case a farmer with a five-acre plot had been furnished with a 9 inch pipe outlet. This inequity was pointed out to the IE who agreed to replace it immediately with a smaller outlet pipe. In other instances, the farmers were able to point out that because of relative field levels, field-to-field flow of water was the only possible arrangement if coupled with a larger pipe at one suitable point, instead of the standard size pipe to each of the fields. Had this not been pointed out by the farmers, the design would have repeated the standard arrangement and caused continuous further frustration.

ii Extension to FC - In many cases where the ID was proposing to make new constructions or extensions of FC the farmers were able to point out that either enlarging the existing outlet or regularizing the device by which they were already obtaining water would be far more effective and economical.

iii Reinforcement of structures - The farmer were able to point out through their experience, locations where the force of water flow necessiated reinforcement of the bunds with concrete.

iv Essential farmer needs - The places where bridges should be located and where bathing places and wallow-holes for cattle should be provided could only be pointed out by the farmers neglecting these needs would lead to great unhappiness

among them, but these were also means which if used would protect the channel bunds from deterioration.

However, both farmers and ID officials questioned by us in our survey have said that sometimes only about 35% of the farmers attended design meetings though of course there were meetings which were attended by more than 90% of the farmers in certain field channel as reported by Ranasinghe Perera. Of those who attended the design meeting, 67% of the farmers, among our respondents, felt that at least some of their suggestions, were incorporated in the eventual rehabilitation. But one diappointing feature was that 90% of the respondents said that when their suggestions were not incorporated, they were never informed of the reasons. The ID of course always pointed out the design engineers' lack of time. In fact, the earlier plan of having two proper meetings, one to discuss with the farmers their suggestions and the second to explain to them the feature of the new design, was given up in favour of 'walking the channel' in order to conserve ID time. But considering the amount invested in rehabilitation and the frustration that farmers still voiced about deficiencies in the rehabilitation work it would have been well worth the time and money, had greater provision been made to liaise more adequately with the farmers on this matter.

Farmer Participation in Earth Work

Farmers were assigned the responsibility of carrying out the earth work falling within the field channel, and they were expected to do this without any remuneration. There was not prior consultation with farmers before this project design decision was made. It was hoped that the farmer organizations would mobilize the farmers in the respective field channels

to carry out this part of the rehabilitation work. The results, however have been far below expectations. Ranasinghe Perera reported in his study that out of the field channels in the Uhana area which had attempted earth work between 1981-1983, only 4 had completed 75% of the week. ID officials complained that this work has lagged far behind schedule and point this out as one of the factors hampering timely completion by the ID of structures at field channel level. Of the farmer who were questioned regarding earth work, only 1% claimed that they had done all the earth work assigned to them while another 25% said they had done up to 75% of the work required of them. 40% of the respondents conceded that they had done less than half the work expected of them.

Though FO appear to have made or attempted to start this work, it seems to have been an unrealistic expectation from the very beginning. Many of the field channels are too long for farmers to complete this work on their own. And on many field channels, there are a large number non-owner cultivators who have been unwilling to participate in such tasks. The failure of ID to keept to its own schedules for construction work also may have been a reason for loss of enthusiasm on the side of the farmers. Furthermore, the farmers could hardly be expected to perform these extensive works without any remuneration, while all around them, rehabilitation-related jobs were being farmed out to private contractors who were all allegedly making heaps of profit. Had the farmers, for instance, through FO been encouraged to undertake contracts in field channels for the construction works, it might have been easier to persuade them to contribute their labour free for the earth work. Also some of the work done was not supervised by TAs and was not done correctly, so it was not counted but farmers were reluctant to do the work again as it was all unpaid.

It should also be mentioned here, at least to balance the picture, that in numerous instances, FOs have always literally

rushed to the breach when emergencies arose and structures had to be repaired without even looking for any payment or ID help. Several jobs which the ID had neglected to attend to despite repeated requests by farmers have been done by FOs on their own initiative and without any remuneration from anyone. The following are some of the examples of jobs done by FOs without payment and on their own initiative: (i) Repair of breach on distributary channel LB 29 in Gonagolla, 38 farmers from FOs on LB 29 worked for 2 days to complete the work. The work done was estimated to be worth Rs. 4,000/- (ii) At the tail end of the LB 7, a drainage channel was constructed. Sixty farmers worked for 5 days and the work done was estimated to be worth around Rs. 50,000/-. (iii) On UB 2.3, there was a leak and the ID labourers were found taking a very long time to repair it. The farmers took over the task and completed the work with no cost to ID.

Farmer Organizations and Contracts

Two of the FO have succeeded so far in securing contracts from the ID to do rehabilitation related construction tasks. They have made handsome profits and the work has been judged very satisfactory. After the farmers who contributed their labour were remunerated adequately the balance which remained (in one instance, the profit was Rs. 6,000 from a contract which was worth Rs. 44,000) has been retained as profit by the FOs in a common fund to be utilized to extend credit facilities to farmers for the purchasing of inputs. The success of the two FOs has encouraged others and 15 others FOs have registered themselves as contractors with the ID. Despite several attempts, the ID has not granted any of them a single contract even though it had been publicly stated that this would be done. This is very unfortunate for had these contracts been awarded, it would have strengthened the organization not only financially but in other ways as well. Taking part in the construction of the

structures in their own areas would no doubt have contributed to the farmers acquiring a greater regard for their care and maintenance thereafter.

Farmer Officer Contacts and Relationships

Farmer Responses

Farmers as well as officials from Irrigation and other concerned Departments were questioned about the contacts between farmers and officials. They were asked whether there was any improvement after the advent of FOs in their contacts and in farmer and official attitudes towards each other. The changes which have taken place are reflected in five tables at the end of this chapter.

After the FO there is an improvement seen in the level of contacts as well as in the satisfaction farmers get from these contacts (Table A19). While 63% of the farmers questioned said that they had no contact with any of the ID officials before FOs, after the FOs this percentage had come down to 48%. And the percentage of persons who were satisfied in their contacts doubled from 15 to 30 though the percentage of persons who failed to find contacts satisfactory remained the same. Farmers were also questioned regarding their contacts with Agriculture and Agrarian Services Department officials. Here too, though the level of contact with these seems to have been significantly higher than with ID officials even before the FOs., after FOs there has been an increase. (Details with respect to contact with different officials are given in Table A20).

Farmers were questioned about their perceptions of officials in terms of their responsiveness to the farmers. The percentage of respondents judging official attitudes 'good' and 'very good'

showed very significant increase after FOs. With regard to ID officials, the increase ranged from 31% in the case of work supervisor to 300% in the case of the DDI Ampara. With regard to the Agrarian Services and Agricultural Department officials, the increase was slightly less but the figures were more positive even before FOs. (see Table A21). The percentage of respondents judging official attitudes 'poor' also recorded a significant decline. In the case of ID officials the decline averaged around 60% (See Table A 21).

Officer Responses

30 officers were interviewed, and 73% of them felt that the FOs had led to better officer-farmer relationship. 63% of the officials also said that the FOs had facilitated better communication between farmers and officials while 66% of them felt that the FOs had promoted greater understanding and trust between the two groups. And 50% of the officials felt that FOs had bred greater confidence among the farmers, in their dealings with the officials (see Table A22). And 74% of the officials felt that FOs did well in representing the problems and needs of the farmers to the officials and other farmers outside the area. 80% of the officials also felt that the FOs did a good job of communicating information from the Irrigation Department to the farmers. (see Table A23).

The increased contact which has been noted as well as the improvement in attitude has, in so far as it is valid to attribute it to the work of FOs, been achieved in many ways. Field channel level farmer meetings have been responsible for communicating ID decisions and information to farmers as well as to promote farmer understanding of ID operations. At D-channel level, FO meetings provide a regular forum for ID and other officials and farmers to get together. Almost all the officials (except 2) who were questioned had attended all or

most meetings which had taken place in their areas. Seventy per cent of the officials said that they went to some of them.

The officials from the Agricultural Department find the new cohesiveness among the farmers a great asset in the dissemination of innovative ideas. To the KVS, for instance, who has been set targets regarding the number of persons he should meet each month, the communication network provided by the ROs and FRs makes things very easy. This would explain the reason for the greater enthusiasm shown by Agricultural and Agrarian Services Department officials than even by the ID.

The re-orientation of the attitude of ID officials and farmers towards each other has been facilitated to a large extent by the participation of farmer groups in design meetings. These meetings served not only to provide opportunities to air farmers grievances but they also went a long way towards the creation of an attitude of mutual trust and respect between the two groups. The farmers are now able to see, to a large extent, the constraints on the ID. The ID officials on the other hand get a better view of the farmers, in contrast to the picture they had of them as irresponsible sabteours of structures and wasters of water, seeing them now as people who have genuine grevances, who know what they need and who could provide them with much needed information about field channels and contitions. The ID engineers now found their task at FC level made much easier and were not averse to acknowledging their dependence in this respect on the perceptions of farmers.

Institutional Organizers: Recruitment and Training

Recruitment

The project of forming FO, was carried out in the field by Institutional Organizers who were recruited and trained by ARTI-Cornell. It was decided to employ only graduates.

The first batch of IOs were recruited from among graduates who applied in response to an advertisement in the press. Thereafter in accordance with Government stipulation, recruitment was from unemployed Graduates registered with the National Youth Service Council. At the time of recruitment of the first batch, there had been some unemployment among Graduates in the country and almost all IOs recruited had already spent two years, at least, after grduation. The subsequent batches of IOs were recruited from young men and women who had just left University.

The changes in employment conditions in the country between the time of recruitment of the first batch and thereafter has made a drastic difference to the programme given the decision to utilize graduates.

The decision seems justified on the basis of experience. The graduates were able to understand quickly the concepts involved and have a sense of the experimental nature of the programme. As was foreseen, the contact with government officials, particularly the officers of the ID was also easier to them than it would have been to non-graduate due to status differences. The work of the IOs in the field was very much facilitated by their role as facilitators of communication between the farmers and various levels of government officials. This is very much so in Sri Lanka's context where status differences are perceived straightway in any encounter. The usefulness of the original decision to confine recruitment to graduates was confirmed by the perceptions of departing IOs as well as by IDs officials. The insistence that all recruits should have a farming background has proved sufficient to enable a ready rapport between the IOs and farmers. Since it was an essential part of the programme that the IOs would live among the farmers and also cultivate close contact with them this insistence on farming backgrounds proved very useful.

In the Sri Lankan context where the work ethic is not very pronounced at least among public service cadres, a sense of vocation was considered to be essential for this highly service oriented programme. This was sought by looking for backgrounds with social service involvement among the applicants. This became particularly important in view of the fact that though there was supervision and monitoring by ARTI and Cornell, for most of the time the IOs were on their own in the field. More importantly it was essential that IOs did not become satisfied with just a formal structure of FOs and always be fully alive to the spirit and context of the participatory ideal.

Training

The training consisted of 2-3 weeks of "formal" training in Colombo and field training in Amparai for a period of 4 weeks. The formal training consisted mostly of lectures and discussions of the broad areas of Agriculture, Irrigation, Local Institutions and Communication. The philosophy of participation was emphasized and the IOs at this stage were divided into groups and were given exercises to introduce them to the participatory approach. The nature and extent of the training varied from batch to batch. Some batches received more of the "formal" training and less of the field training while some others were exposed to more training in the field.

The IOs who have been in the field feel that the formal training could be reduced and more emphasis placed on introduction in the field. Through the training and fielding of six batches, requirements have now become clearer. Many of the lengthy disucssions on the technical aspects of farming can, it is clear now, be cut out and the formal introduction can be confined to clarification of the philosophy and principles of the participatory and bottom-up approach. The relevant technical knowledge is more easily, and at less cost, acquired

by recruits being apprenticed to serving IOs. The field training of the later batches was always facilitated to a great deal by the presence of senior IOs in the field and by contact with Farmer Representatives who could explain the programme from perspective.

The ARTI also conducted sessions of in-service training to the IOs after they had spent 6 to 9 months in the field. In these sessions the IOs could exchange and discuss their experiences and problems in the field with the ARTI and Cornell staff involved in the programme. The regular visits made by the members of ARTI/Cornell team to the field also served to strengthen the in-service training component especially through the extensive discussions which the IOs and researchers had, very often in the presence of concerned farmers also. Professor Uphoff's visits to the field, made twice a year for the past five years have served as a regular component of IO training. The lengthy discussions have served to identify problems correct slips in perspective and to deepen the understanding of the participatory approach as it confronts problems. These trip discussions and the written material coming from him have been of help to the ARTI, Cornell local staff involved in the training.

An attempt has been made to gather and present the lessons of all the training gone through so far in a Manual of Training prepared by ARTI. It sets out the components that should go into any future training programme for IOs. But the departure of all the trained IOs from the field except for eight who are still there (out of 169) means that the scope for apprenticing new recruits is now greatly reduced. In evaluating the results of the training programme, the following points could be made:

1. The training was very relevant and made signifincant contribution towards preparing the recruits for their tasks.

2. The local resource persons who were involved in the training were able to draw important lessons from each programme and every succeding programme incorporated new features. After each training programme, the course content was evaluated and modifications adopted. These resource persons are available for utilization in similar training projects anywhere else in the country. But it has to be pointed out that failure so far to establish a permanent home anywhere for Institutional Organization in Water Management is a serious drawback. The ID has so far not concretised its agreement to absorb a core IO Unit. Ministry plans have not materialized yet. The continuity of resource person availability is therefore in danger of being lost.

3. The Manual of Training makes available to ofhers the experience gathered by the programme.

4. The departure of all but a handful of the experienced IOs who were the recipients of the training is a great loss to the programme. And the fact that most of them have gone into fields, such as teaching in which they are not likely to utilize directly the organizational skill acquired by them, represents a significant loss of the investment in training costs. A few of them have joined service organizations where their training is relevant.

5. The training of recruits in the participatory approach and their engagement in the field have made perceptible changes to the personality of these young men and women and even as teachers-

what the vast majority of them have become- they are far better contributors to the common good than they would have been otherwise. This was seen in a feedback session arranged by Cornell with departed IOs after a period of work as teachers in schools all over the country.

IO Turnover and Permanancy

The first batch of 30 IOs were fielded to cover 5000 acres, i.e. at the rate of about 150 acres per IO. It was proposed that as the programme progressed, IO strength in the field would be reduced and that the more experienced personnel would be able to cover a larger field. As it happened however, IO presence became in fact thinner more quickly than anticipated for an altogether different reason. The launching of our programme coincide with a massive recruitment move by the Government Department of Education and this led to the departure of IOs from the programme in large numbers as has been mentioned before. As a result, 41% of the IOs served in the programme for less than 6 months and therefore could make little contribution to it. Out of the others, only 43% have stayed for longer than an year. (Table A24). Thus, though 6 batches and a total of 169 IOs were recruited and trained, effective IO presence in the field has never exceeded 50 and the average has been around thirty.

The disruption of continuity of organizational work in the field has therefore been drastic and this has had several adverse consequences.

1. The lack of continuity has prevented us from making any reliable assessment of the time required for the development of strong institutional organizations among the farmers under sustained guidance. Even the

possibility of monitoring accurately the factors that help and hinder the growth of strong institutions has been affected. The whole question of replicability or extendability of the IO programme is thus blurred. We are not in a position to evaluate

i how long it would take and IO to build a strong organization which is capable of sustaining itself; and

ii how much area an IO can cover effectively at different stages of the programme.

As it happened, our intention to thin out IO presence in the field could not be carried out in any orderly manner. Whenever IOs left, the area had to be shared out among those who remained. The IOs in the first year had about 150 acres each. As a result of the departures, in the second year they had 300 acres each, in the third year 750-1000 acres each. This increase was not based on any evaluation from field results.

2. The effect on the FOs has been uneven development. Some of the FOs are strong while many others are weak or exist in form only without having had support in their early stages to develop the content and spirit necessary. Feedback from IOs and FEs definitely indicates that the really vital FOs are those in which the IOs have worked for at least an year.

These considerations bring up the question of tenure for the IO recruits. It has been proposed that it would be useful to have the IOs contracted for 2 to 3 years, but to recruit permanently the more effective and dedicated among them into an IO unit to be established either in the ID or with the Ministry of Lands. This latter plan if implemented will have

the benefit of consolidating the training and organizational skills that have been accumulated over the past five years thus reducing costs of training in the future for the whole country. If this is done the training of so many IOs would not have been wasted. But it has to be done soon i.e. before the IOs who have gone elsewhere loose their spirit and service-oriented outlook which has now prompted many of them to express the desire to return to working among farmers if given the opportunity to make a career of this.

There is also a problem with the proposal to keep the bulk of the IOs on a temporary basis with contracts for two or three years. The offer of permanent employment with the Department of Education will always be an effective pull-factor, and as long as the possibility remains that there will be recruitment by the Department of Education we can never be sure of holding the IO for any length of time. In Sri Lanka despite the transience of everything emphasised by the religion, there is a great premium placed on permanency. No amount of monetary incentive or sense of vocation really can stand up to offers of permanency from elsewhere. No programme can afford to incur the loss which has occurred twice, of having almost whole batches of trainees leaving soon after the training was over. Some new strategy has to be devised. One possibility is to impress upon the Department of Education the national importance of the IO programme and its possible benefits to the Department of Education itself in terms of enriched personnel and to persuade them to enter into secondment arrangements whereby IOs could complete their contracts with the programme and go into teaching at that time without any loss of service standing. Such arrangements are not unknown in Sri Lanka and if the urgent importance of large irrigation schemes and the peasant sector is understood, such an arrangement should be possible.

Supervision of IOs in the Field

The IOs in the field were supervised by Research and Training Officer who were appointed for thetask from the Water Management Division of the ARTI. The R&TOs were based in Colombo and made periodic visits to the field.

A Senior Officer from the Ministry of Lands was seconded on a part-time basis as the IO supervisor resident in Ampara. He was also expected to help the IOs in sorting out administrative and logistic problems which arose from day to day. Two Cornell local consultants, one full-time and another part-time, made periodic visits to the field to be consulted by the IOs as well as visiting R&TOs. During the first two years of the programme, the supervision of the IO by ARTI and Cornell personnel was close and systematic. There was a Process Documentation component to the programme and this was made use of and feedback provided to the field. Thereafter there has been a decline in the degree of supervision. The following reasons, among others, may be given.

i There was continuous turnover of the R&TOs attached to the programme - either they left or went abroad for post-graduate studies.

ii ARTI which had taken up the programme as an action research project had never bargained to become permanently engaged in looking after Farmer Organizations. In the latter years, there was continued administration of the programme but without much engagement in the learning process or in monitoring the conceptual development of the programme.

As a result, Process Documentation was not monitored and no check was kept regularly on what was going on in the field or

even on the format of the documentation records themselves, or if any format was attempted there was no follow up to see that it was being adopted.

This, however, is not a criticism of the ARTI for as a research-oriented institution, they had always expressed their reluctance to continue with the operational tasks such as were entailed by the IO programme after the first two years, which is as long as ARTI had initially agreed to administer the programme. As a result the only readily available continuous documentation of the IO programme for the past 5 years is that provided by the series of trip reports and other papers produced by Professor Norman Uphoff.

Cost of the IO Programme

Table 7 shows the total estimated cost of the IO programme for the period 1981-1985 and Table 8 indicates the cost of training and maintenance per IO.

The rapid turnover of IO has meant that the average tenure of an IO has been around 12 months. If they could have served 2 years the training costs would have been at least halved and costs of in-service training administration and supervision also would have been much less. The rapid turnover and the consequent need to introduce repeatedly fresh recruits increased tremendously the need for R&TO involvement and travel costs to and from Colombo all of which are included now in the estimated maintenance cost.

Table 7 : Estimated Cost of IO Programme 1981 - 85

	Rupees
Training:	
169 IOs @ Rs. 5,000	845,000
Maintenance in the Field:	
2006 man-months @ Rs. 4,505	9,036,805
	9,881,805
Average Annual Cost (for 5 years)	Rs.1,976,361

Table 8 : Approximate Cost of One Institutional Organizer

		per month Rupees
1. (a)	Salary 1 @ Rs. 1500/-	1500.00
(b)	Travelling and Subsistence 1 @ Rs. 400/-	400.00
(c)	Stationery Rs. 100	100.00
(d)	Bicycle, mosquito net, torch, other capital costs	175.00
(e)	Administration and Supervision*	2000.00
(f)	In-Service Training	330.00
	Total monthly cost	Rs. 4505.00
2. Cost of initial recruitment and training per IO		Rs. 5000.00

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* Includes salaries of R&TOs, Travel costs, Supervisor honorarium, office support. Does not include the cost of consultants.

The FO Programme and Leadership among Farmers

One of the objectives of the promotion of FO was to encourage such qualities as self reliance, confidence and initiative among the farmers. The IOs understood clearly that it was not their role to function as the leaders of the farmers but to serve as catalysts and to foster the processes by which farmers themselves would develop leadership qualities. Farmers were made to understand clearly that the IO presence in the field was only temporary and that they themselves will have to perform the roles and tasks which, at most, the IOs were there only to make them realize as being well within their capacity.

The process by which the IOs encouraged FO and the selection of farmer leaders has led to the emergence of less self-seeking or authority-minded leaders. The organization of Shramadana activities, attendance at design meetings, group discussion initiated by IOs and most importantly the emphasis on consensual selection have all contributed to the identification of service-oriented leaders who are generally not power-seekers. The FR personality which has emerged through these processes has turned out to be entirely representative. A survey among FRs showed that the persons selected, contrary to traditional patterns, were men without any power base arising from wealth or political association. 30 per cent of them owned less than 2 acres, while 90 percent owned less than 4 acres. Farmers however seem to have paid some respect to the benefits of education, particularly to the ability to articulate ones ideas. Seventy per cent of the FR were men who had passed at least the 6th Standard, many of them going up to the 10th Standard, while 5 percent had gone even higher. The average educational level of the farmers is much less. Thirty per cent are illiterate and the bulk of them are able to claim only an ability to read and write.

Sixty-six per cent of the leaders chosen are men who had already demonstrated their orientation towards service by having taken active interest in voluntary organizations in the area - such as Death Donation Societies, Rural Development Societies, etc., and 43 per cent of the FRs are office-bearers in at least 2 other service-oriented organizations besides being leaders of the FO.

The consensual approach has been found to be remarkably useful not only in choosing persons acceptable to almost all farmers but it has turned out to be very effective in ensuring farmer support and cooperation for the leaders chosen. The practice encouraged by the IO of engaging in discussions about the role of leaders and the qualities desirable in persons acceptable as leaders has been another factor which has contributed to the smmothness of the selection process. In fact, the sense of accomodation and goodwill which has attended the choosing of FR has been a striking feature in the formation of FO and the decision in many FOs to have two FRs instead of one in order to accomodate and benefit from the more than one keen and acceptable person who was willing to serve, is as much as demonstration of this spirit of accomodation as of the flexibility of the FO structure.

The consensual process of selection has also eliminated what was observed in the course of a study on the Wattei Vidanai System, within GOLB, namely the very undesirable involvement and interference by outsiders such as officials in WV elections and a tendency for all manner of corrupt practices to creep into elections including tampering with Paddy Land Registers. It was also found in the WV study that political conflict which was normally not a pronounced feature of life in the tract appeared during election time. By doing away with elections and adopting the consensus approach, a major temptation to politics has been eliminated in the FO programme.

The IOs in the field were asked to rate the FRs based on leadership qualities such as self-reliance, initiative, ability to mobilize farmers, decision-making etc. The result of their rating on a scale of 0-100 is given below:

	Percentage of FR
0 - 25	3%
26 - 50	15%
51 - 75	44%
Over 75	28%

The leadership that has emerged as a result of FO activity has received confirmation of its effectiveness by acknowledgement outside the FO areas also in many ways. As early as 1982 the Government Agent, Amparai, decided, with the agreement of District Minister, to invite four farmer representatives to meetings of the District Agricultural Committee, which hitherto was composed exclusively of district-level department heads and Members of Parliament, thus giving the farmers a much needed voice to represent their point of view at these meetings.

This farmer representation in the DAC was effective, for example, in obtaining additional PMB purchasing centres in the Uhana area.

Farmer Organizations and Politics

One of the features of the development of farmer organizations so far is the high degree of vigilance shown by all concerned - the IOs, the farmers themselves, officials as well as the politicians concerned in the programme, to keep politics out. In the choice of office bearers as well as in the conduct of meetings, great care has been exercised to avoid political bias or the appearance of political bias. No FO has been reported to be polarised according to the political party

division in the country or in the area. It is more the rule than the exception to find farmers identifiable as belonging to rival political parties holding office in the same FO. It is not at all unusual to find farmers belonging to rival political parties nominating each other to offices in the FO. In meetings of FRs, care is taken not to give unbalanced prominence to politicians belonging to any particular party.

Of the 163 FRs who responded to our inquirty regarding the intrusion of politics in FOs in the choice of office bearers, 154 of them denied that there is any politics. All of them emphasized that if politics was not kept out of the FO, it would seriously undermine the capacity of the farmers to act together as farmers and that the FO would rapidly break down. Apart from farmer convictions, the strictly professional attitudes maintained by the others working with them including the Government Agent, the District Minister and the DDI Amparai has been a very important factor in keeping the FOs political so far.

Evaluation of the Strategy Adopted in the Promotion of FOs

The Introduction of IOs to Function as Catalysts

The idea of introducing IOs to function as catalysts to change the attitudes and behaviour of the farmers in the field channel areas was sound as has been demonstrated by the performance of the FO. The decision to get the IOs to live among the farmers was also correct in that it facilitated the development of the trust and understanding which enabled the farmers to follow on through the 'suggestions' of the IO. By living among the farmers, the IO gained acceptance much more rapidly and completely than would otherwise have been possible.

IO Coverage - Extent of Field Responsibility and Schedule

The extent of area and the number of farmers among whom an IO can work effectively has been found to depend on the stage at which the programme is in each case. At the initial stage when farmers are being familiarized with the idea of participation and also with the role of the IO himself, a more intensive presence is necessary. Once the FO have been formed, the IO presence can be reduced, for his role is now for the most part confined to assisting the FR and contact with individual farmers is not needed. Once the FO has functioned for some time and has been found to be strong and adaptive, the IO presence in the field can be made very thin indeed and it would be sufficient if they perform consultative functions.

The schedule given below is however only tentative and needs adjustments depending on the field conditions.

Time Schedule for FO Promotion Activities

	Duration	Range per IO	Objective	Activities
Phase I :	12 months	500 acres or 150 farmers.	Working towards formation of FO at FC level.	Contact with individual farmers work as Catalyst motivator and facilitator.
Phase II :	6-12 months	1500 acres	Consolidation of FCO and formation of DCO and Area Council	Contact with farmer groups and advisor to FRs.
Phase III :	Continuing	3000 acres	Maintenance	Consultant functions to FRs, DCO & AC, training, monitoring trouble-shooting.

Prior exposure, for instance, to the participatory idea even by hearsay may make a difference. In Paragahakele it was possible to form FOs with very few IOs and very rapidly, sometimes within a month and a half of the IO entering the field. Meeting individual farmers was not necessary since most of them were already familiar with the FO idea that was taking hold in the adjacent areas. As has been mentioned already, these time schedules and extents may bear adjustment.

The kinds of activities which the IO can undertake at various stages are also not strictly divisible. For instance, the formation of DCO and Area Councils need not always await the completion of the work of forming the organization at the respective lowere tiers. It is possible or even advisable perhaps, to go ahead with the higher bodies so that the vertical linkages thus created lend interlocking support and strength to the whole process.

Bu the idea of using officials such as Irrigators or Cultivation Officers to take on the role of catalysts has been found to be unsuitable. These officials already have clearly perceived roles and ther fore find it difficult to appreciate fully the flexibility associated with the participatory approach. It is also important that the catalysts who set out to build attitudes of self-reliance among farmers, be completely free from prejudices which deny the latter equality of status.

The Decision to Employ Graduates as IOs

The decision to employ graduates as IO was justified. The graduates were more capable of understanding the concept of the participatory and bottom-up approach and also to adapt themselves to the flexibility in the experimental approach. The fact that they were graduates also facilitated their

acceptance by the officials with whom they came into contact and this in turn gave them greater effectiveness in the initial phases in organizing the farmers.

It was decided that IOs would be hired on short term, and that some of them who showed the capacity and aptitude to be "organizers of organizers" would be taken into a permanent cadre to serve the programme in GOLB as well as elsewhere in large irrigation schemes.

While thid decision still remains valid, improvement in the employment conditions of graduates in the country has created severe problems. The absence of tenure prospects as IOs made most of the IOs leave for permanent employment, mostly as teachers. Some arrangement therefore is necessary which would ensure that the trained IOs remain for a minimum period of time. A possible solution would be to work out with the Ministry of Education some arrangement, to retain IOs recruited as teachers, on secondment until they complete their contract.

Farmer participation and the necessary change in farmer attitudes requires a reorientation of the attitude of the bureaucracy, including ID officials, towards the farmers. In the GOLB experience the arrangement of ID officials and farmers interacting in design meetings presented some opportunity to achieve this bureaucratic reorientation. It is clear that in any project of this nature, similar opportunities ought to be devised for this purpose. Changing the attitudes of farmers or of officers cannot be done in isolation from each other but only through situations which permit perceptibly mutually profitable interaction.

The informal approach and the process, as opposed to structural, planning have been extremely fruitful. Apart from providing flexibility and adaptiveness according to varying field conditions, the informal approach has led to the development

of active organizations which have not degenerated into the formal but empty structures run and 'owned' by a few persons - the fate of many officially instituted bodies.

The choice of field channel areas as the territorial units for the operation of FO instead of, for instance, the larger tracts which were in the charge of the Yayapalakas, has been advantageous, The FC area is hydrologically more cohesive unit and shares the same conditions and problems. Also the relatively samller size of the FC area seems the more suitable for the informal operationas of the FO in view of the fact that FRs are voluntary, unpaid workers. In fact where field channels are long, the farmers have on their own opted to have more than one FR. The size, that has emerged as the optimum in practice seems to be about 1 FR per 15 farmers.

The involvement of FO in activities other than water management was initially not encouraged on the assumption that such involvements would tend to distract the energies of the FO. But it is our experience that if the organization is to be sustained, it has to engage in some useful activity of relevance to the group when water management relafed tasks are done, if it is not to die of ennui.

The adoption of the team concept by which a team of IOs were responsible for working in a whole area instead of the allocation of a smaller area to each individual IO had very positive results. The team spirit and the comaradarie of the IOs among themselves was eventually reflected in the attitudes they communicated to the farmers.

The correctness of decision to include females in the recruitment of IOs has been indicated both by the wide acceptance they have enjoyed among farmers as well as by the efficiency they have shown in the field.

Chapter III

WATER DISTRIBUTION

Having discussed the major components of the Gal Oya Water Management Project - namely the physical rehabilitation and the introduction of new mechanisms such as farmer organizations to improve systems management - we shall now be concerned with the analysis of the impact of these project components on water distribution. This chapter examines the changes observed in seasonal and spatial distribution of water in the Gal Oya LB system over the project period. Subsequent to this analysis, the next chapter will analyse the changes in crop yields during the period under reference.

Analysis of the spatial distribution of water within an irrigation scheme is useful not only in studying the spatial differences in the crop-yield distribution but also in understanding such other aspects as: 1). Equity in water distribution, and 2). Efficiency in managing water at different levels of the system. In this chapter, Water Availability Index (WAI) is used as an "estimate of the adequacy of water distribution at farm level. The discussion on the spatial and temporal variation in water distribution using WAI will be based on the data gathered from the farm record-keeping programme during the period 1979/80 to 1985/86. In this chapter, first we will describe the methodology followed in computing WAI. Second, using WAI we will examine the pre-project status in regard to water distribution. Next, the changes in water distribution over time will be analysed.

3.1 Water Availability Index

On the basis of daily observations on water status of sample farm plots, a Water Availability Index (WAI) was computed for each farm, using a simple system of weighting to indicate the degree to which a farm's crop had more or less water available during the period 20-70 days before harvest.

The investigators were trained in methods of assessing visually the water availability in farmers' fields, so that observation errors could be reduced as far as possible. Five conditions of water availability were specified and daily observations were made for each farm covered by the record-keeping programme. Within each farm, observations were made for two selected liyaddas from the date of planting to the date of harvest, the liyaddas having been selected so that one was near to and the other far from the pipe inlet supplying the farm allotment with irrigation water.

Investigators recorded for each selected liyadda each day the water status of that plot whether it had;

(a). Severe shortage of water (soil cracking)
(b). Moderate shortage (soil dry)
(c). Saturated condition (soil wet)
(d). Standing water
(e). Flooding, or flowing water.

On the basis of the conditions observed, WAI was computed for each farm, using a simple system of weighting to indicate the degree of water status during the critical period (or the water sensitive reproductive phase of crop growth) between 20-70 days before harvest. To calculate the index, the number of days in the first category ('a': severe shortage) were added to the number of days in the second category ('b': moderate shortage), which were weighted double plus the number of days in the third category ('c'; saturation) weighted triple; and the last two categories of abundant water supply ('d'; standing water and 'e': flooding) weighted as quadruple.[1]

1. This can be expressed as follows:-
WAI = (ax1) + (bx2) + (cx3) + (dx4) + (ex4); where
a = no: of days of severe shortage within critical period
b = no: of days of moderate shortage within critical period
c = no: of days of saturation within critical period
d = no: of days of standing water within critical period
e = no of days of flooding within critical period.

Once the WAI was calculated for each liyadda; an average WAI was calculated for each farm, for those farms along the field channel at the head of the D-channel etc:. This procedure permitted comparisons such as 'head' versus 'tail' within D-channels.

The utility of WAI for the analysis of irrigation system performance comes chiefly because it is smiple, easy to measure and cheap. Furthermore, it is a highly integrated variable reflecting the effects of potential evapotranspiration demand, farmer water management practices, bund leakage, seepage, effects of rainfall etc:. However, WAI as used in this report does not account for the different impacts on yield caused by equivalent intermittant and continuous stress periods. Similarly it does not incorporate the effects of water stress during the vegetative period.[2]

3.2 Status of Water Distribution Prior To Rehabilitation.

Pre-project analysis revealed that in the study area a considerable portion of the irrigable land had reverted to rainfed status. Inequitable distribution of water was prevalent throughout the LB system of Gal Oya. Major variations in supply existed not only in regard to volumes delivered but also in the length of irrigation issues. Water schedules decided at the cultivation meetings were not adhered to, and instead of pre-scheduled periodic issues of water, some of the 'head-end' areas were provided with a continuous supply while certain areas in the tail-end never received water at all, which was devastating in the dry season. (Wijayaratna et al. 1982).

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2. A better form of WAI incorporating these aspects was developed in a subsequent analysis. For a detail account of this new form and its utility in Water Management Research see Wijayaratna 1986.

For instance, the analysis of water distribution in the 79/80 wet season revealed the following:

a). Water Deliveries in the Main Canal System:-

Reliability frequency and adequacy of water flow-- all tend to decrease toward the tail end of the channels, whether main, branch, distributary or field channels[3]. The main canal had a continuous flow of water up to the Uhana regulator, below which there was some control over water issues. Tail end portion, on the contrary, were almost entirely rain fed. For instance, a single issue of water, around the 120th day after planting, was reported at the off-take of M31 Distributary. By this time, the majority of farmers were about to commence their harvesting operations.

b). Water Deliveries in the Distributaries and Field Channels:-

Water delieveries in the distributary channel systems also followed the same pattern of delivery as in their respective main channels, indicating a lack of water control. A relatively continuous flow at the head contrasted with the clear cut rotations at the middle portion. The tail end portions were almost rain-fed.

Water flow along field channels was the least reliable and resulting problems were most prominant;

a). in field channels located towards the end of a distributary,

b). along longer field channels, and,

c). generally in the middle and tail-end of the LB system.

3. The term 'reliability' here refers to the degree to which actual water issues follow the water schedule decided at the cultivation (Kanna) meeting before the season begins.

However, it was interesting to note that unreliability occured to a certain extent even in the field channels located at the head-end of the main system. We thus saw that system of tribution through secondary channels (D-Channels) affects field supply quite apart from the primary location of the area, whether head,,middle or tail.

Unfortunately, volumetric discharge measurement in the Gal Oya LB prior to rehabilitation was rare. One illustrative set of readings that does exist is found in Murray-Rust and Cherry (1981) (Cited in Svendsen and Wijayaratna 1982 p. 73 - 74). The data were obtained by means of current meter readings taken along a head-end branch channel on a single day of issue during the early part of the 1981 dry season when water was extremely scarce. All operating control structures were in an open position as was typical for most channels prior to rehabilitation.

These data, adjusted to represent daily supplies per hectare, are presented graphically in Figure 3. . They show the wide range of delivery rates to be found along the upper portion of this largely unregulated head-end branch canal. Actual crop/soil demand for water is probably in the range of 10-15 mm/day in this area, not including conveyance losses. Thus while many of the lower distributary channels along this branch canal fall into this range, many of the head-end distributaries were drawing far more water than they required. If water surface elevations in this branch canal were higher as they would be under more normal conditions, the discrepancies would probably be more pronounced. (Svendsen and Wijayaratna, 1982). Branch canals downstream would have had much lower (and) discharges at this time.

Prior to rehabilitation, the control of water flows was possible only at few locations within the LB area - most of the control structures and gates had been destroyed. The master plan classified the Gal Oya LB system as a 'semi-wild' system (Vol.II p,37). This was because the ID could exercise only minimal measurement and control of flows.

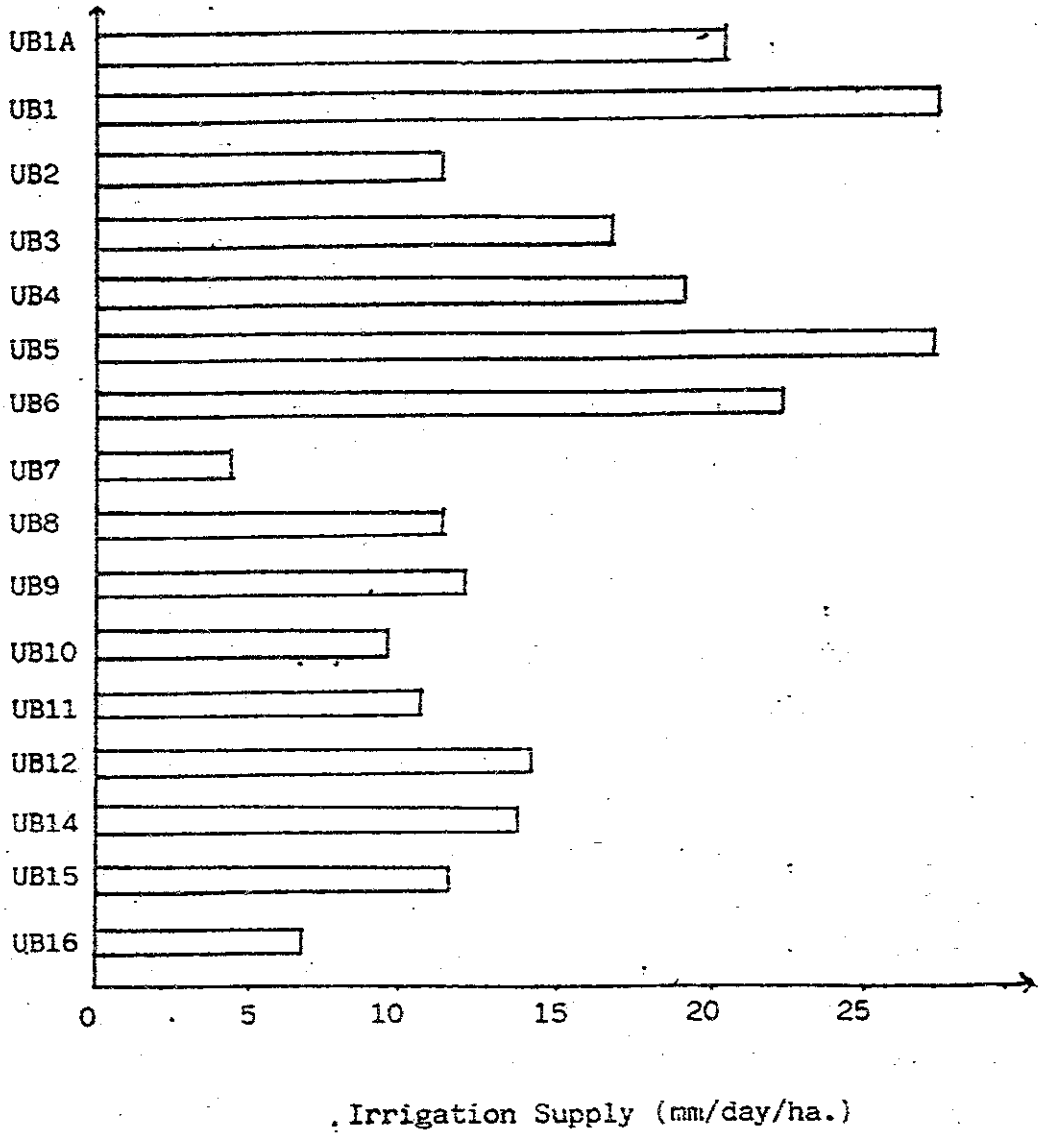

Figure 3.1: Measured Discharges Entering Different Distributary Channels on a Head-end Branch Canal on the Same Day - 1981 Dry Season (Adjusted for the Area Served).

3.3 STATUS OF WATER DISTRIBUTION AFTER REHABILITATION.

Hydraulic performance of the Gal Oya LB system has been substantially improved by the rehabilitation work. Despite the fact that the pattern of rainfall (and, consequently the water availability in the reservoir and in the command area) was favourable over the past few seasons, one may argue that the improvements in water availability throughout the LB system is in large part attributable to the rehabilitation work and the farmer organization activity.

Most of the main, branch and distributary canal system are renovated. The overall progress of the physical rehabilitation work was reported at 72.5 percent as of September 30th 1985 (ISTI evaluation). Despite the fact that a significant portion of the field channel work is yet to be completed[4], the conveyance and control capacities of the main, branch and distributary canals have been improved significantly.

In this section, first, the pattern of distribution of water over time will be analysed by using the WAI. The period of time considered here include both 'pre' and 'post' project crop seasons[5]. Next the 'pre' and 'post' project differences in the distribution of water over space will be examined by using the coefficient of variation of WAI.

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4. As stated by ISTI evaluation : ------ the system is fully rehabilitated and capable of functioning up to full design capacity in only 15 percent of the total area'. (p.5)

5. In some areas of Gal Oya LB, the rehabilitation process had commenced much earlier than others. This aspect or the time sequence of the rehabilitation process is not considered in the present analysis.

3.3.1 Water distribution at farm level:-

The distribution of water in the project area as measured by mean WAI levels during pre and post project periods in Table 3.1. It is clear from this table that mean differences over time are not all that great. This is partly because, adjustments by the irrigation agency for seasonal variations in water supply are made mainly by changing the acreage served and, to a much lesser degree by changing the intensity of management.

Inter-seasonal differences in the distribution of water adequacy within the system can vary due to a variety of factors. Among them are the following:

1). Changes in a) seasonal supply in the main reservoir and, to a lesser degree, the seasonal supply to sub tanks, and b) the area cultivated. These two may be represented by the Supply: Demand ratio.[6]

2). Rainfall in the command area during a particular season.

3). Differences in main system management, for example, the pattern of water issues and volumes delivered may differ from one season to another.

4). Difference in water management at lower levels (field channel and on-farm).

5). Difference in re-use characteristics (e.g: in encroached holdings).

6). Influence of other climatic factors.

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6. This is the ratio of the net available storage in the main reservoir to the area authorized for cultivation.

Table 3.1

WATER AVAILABILITY INDEX CLASSIFIED BY CHANNEL COMMAND AREAS,

1981-1986

SEASON CHANNEL	1981/82 MAHA WAI	1982 YALA WAI	1982/83 MAHA WAI	1983 YALA WAI	1983/84 MAHA WAI	1984 YALA WAI	1984/85 MAHA WAI	1985 YALA WAI	1985/86 MAHA WAI
LB 7	169	178	177	181	173	184	172	179	175
LB 10	176	187	177	180	170	-	168	177	178
UB 2	184	188	189	191	192	192	191	180	183
UB 17	189	186	178	183	184	189	-	193	-
M 1	192	192	177	182	186	187	-	193	-
M 16		170	176	174	185	183	174	171	175
M 31	177		179				185		
G 3	192	175	180	183	192	178	178	179	165
G16		168	166	168	197	185		179	178
G24	160	-	-	-	189	181	180	-	-
LB14	188	-	-	-	-	-	-	-	-
LB19	183	-	-	-	-	-	-	-	-
LB29	192	181	181	171	195	167	173	175	170
LB39	180	178	180	168	183	-	172	192	-
V 2	180	175	180	168	175	-	176	191	-
V21	160	-	158	-	183	175	-	-	-
T10	162	-	-	-	-	-	-	-	-
S 8	-	-	180	177	179	176	172	-	-
-	-	-	-	-	-	-	-	-	-

Source of data - ARTI record keeping/monitoring programme.

A close relationship between the authorized irrigated area in the dry season and the Supply: Demand ration at the main reservoir level has been already established for Gal Oya LB system. (Murray - Rust, 1983; Barker, 1984). Using data pertaining to tank storage and extents authorized, Figure 3.2 illustrates this relationship during period 1977-1985. It is evident from this figure that the level of water in the tank at the beginning of the season determines the area authorized for irrigation.

3.3.2: Project's Impact On The Variability In The Spatial Distribution Of Water In The Left Bank Area.

Water distribution over six seasons measured by WAI is given in Table 3.2

Table 3.2: Distribution of Water Availability Index Over Seasons - Gal Oya LB Area

	Head	Middle	Tail	LB Average
1979/80 wet	185	183	161	175
1983 dry	183	174	173	177
1983/84 wet	189	175	179	181
1984/85 wet	177	175	178	177
1985 dry	183	180	180	181

Source - 1980 Year Book for Sri Lanka Water Management Research, and Seasonal Reports on Gal Oya, 1983-1985 - ARTI.

An indepth analysis of spatial and temporal aspects of water distribution in the same study area has shown the limitations in a 'gross' classification of 'head-tail' areas along the main system. A significant degree of variation exists within each one of these categories. (Wijayaratna, 1986).

There are several sub-tanks within the LB command area. The largest among them, Nawakiri tank, is not totally

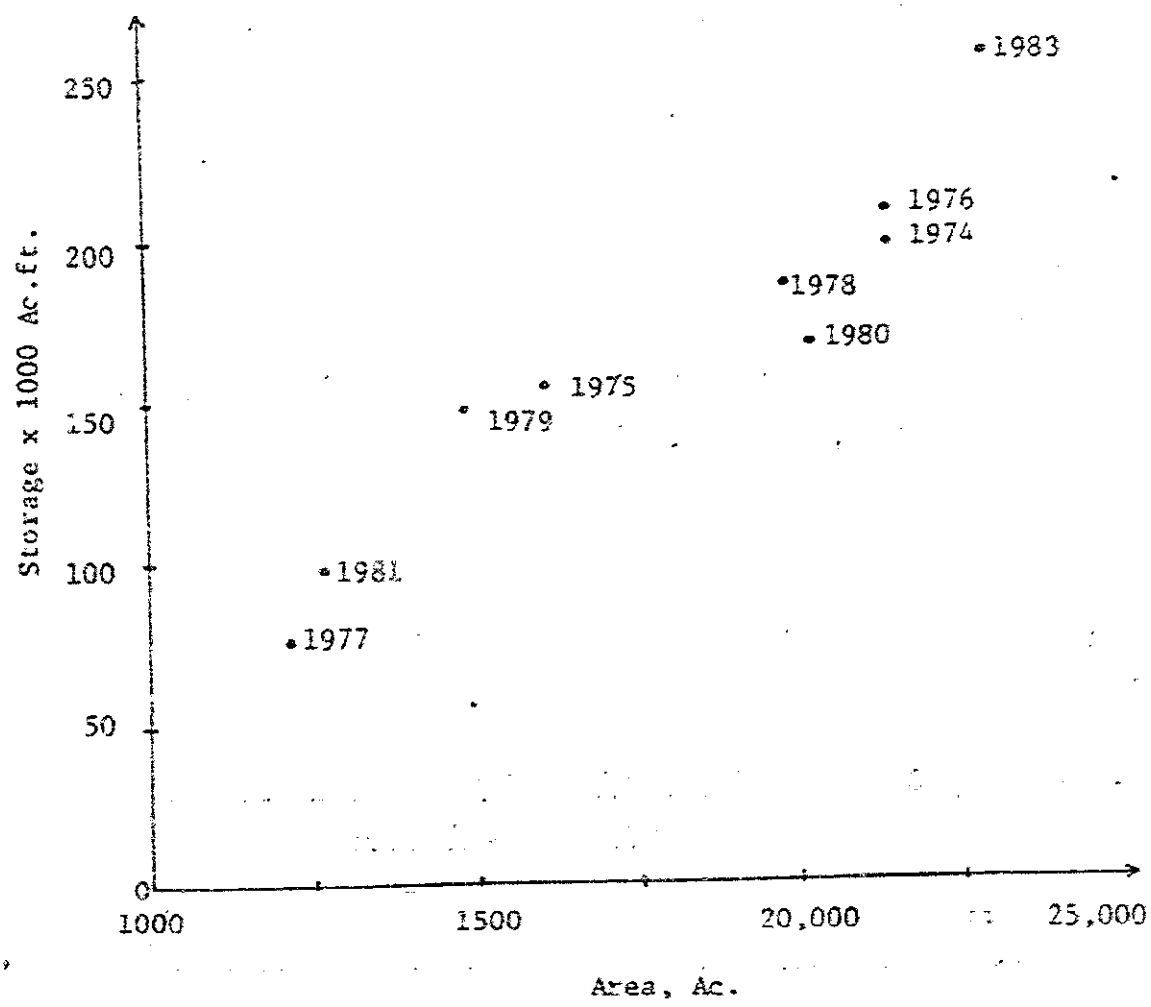


Figure 3.2.: Relationship Between Storage in the Main Reservoir (Ac. ft) and Area Authorized for Cultivation (Ac.) Dry Seasons 1974-1983.

Note: The storage level reached its maximum at the begining 1984 dry season. Consequently the entire area was authorised for cultivation. In 1985 dry season, storage at the begining of the dry season was 551,760 Ac. ft. The area authorised in the Ampara region was about 25,000 Ac. However, the corresponding figure for the Batticaloa district is not known.

dependent on the supply from the Gal Oya main reservoir and has a 'reliable' catchment of its own. Thus, despite the fact that Navakiri tank is located more in the middle of the LB system, the water availability of all the channels in its command area is not necessarily lower than in channels upstream of the system. Similarly, despite the fact that the Uhana-Mandur branch canal takes off from the head-end of the LB main canal, it does not imply that all the farmers served by this branch canal are better off than those at the tail end of the LB main canal command.

Having said this it would be interesting to analyse further the figures in table 3.2 to check if there is a reduction in the variability in water distribution over the project period. In the aggregate level, table 3.2 indicates a tendency of narrowing the gap between different areas of the LB system in terms of mean WAI.

This arguement was strengthened by the analysis of the coefficients of variation of WAI at farm level (Table 3.3)

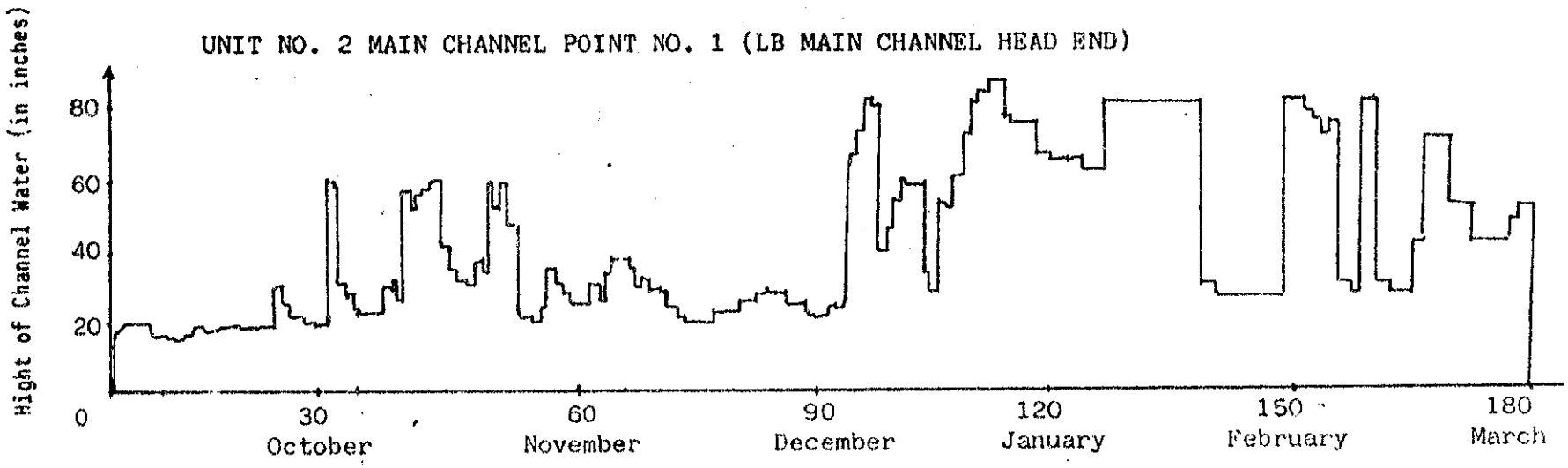
Table 3.3 - Variability in the Spatial Distribution of Water In The Left Bank Area, 1979 - 86.

Season	No: of Farms	Mean WAI	Standard Deviation	Coefficient of Variation
79/80	193	175	14.2	8.1
81/82 March	246	179	11.1	6.2
82 Yala	256	179	7.4	4.1
82/83 Maha	239	177	7.1	3.9
83 Yala	216	177	7.1	4.0
83/84 Maha	298	184	7.8	4.2
84 Yala	334	181	6.8	3.7
84/85 Maha	163	177	6.4	3.6
85 Yala	177	182	7.6	4.1
85/86 Maha	108	175	5.4	3.1

Analysis of the water flow charts (that indicate the flow at different points of the LB system) also supports this arguement. Figure 3.3 'a' and 'b' illustrates the pattern of water flow at different parts of the LB area 'before' and 'after' the water management project. As observed from figure 3.3.a, before the project, in the extreme head end areas continuous flow in the channel system was provided throughout the crop season, whereas at the other extreme, most of the tail end colony units were almost rainfed. Thus it was observed that even without any volumetric analysis, that the adequacy of irrigation supply declines as one moves down the channel system, whether it be a branch canal, distributary canal or a field canal. (Wijayaratna 1982).

On the contrary, the analysis of water flow in the LB channel network over the recent past show that most of the irrigation channels throughout the system were provided with irrigation water in adequate amounts during the cultivation seasons. (Seasonal reports of the Gal Oya Project 1984 Yala through 1985 Yala). Figure 3.3.b illustrates this situation.

As indicated earlier, the rehabilitation programme has helped to improve the hydraulic performance of the Gal Oya LB system: most of the damaged structures in the main, branch and distributary systems are renovated. Consequently the degrees of control of water distribution within the system has been increased. In addition, the farmer organization programme has helped farmers to participate actively in system management. All these facts would have led to an improvement in the <u>equity</u> in water distribution in the Gal Oya LB system over the recent past.



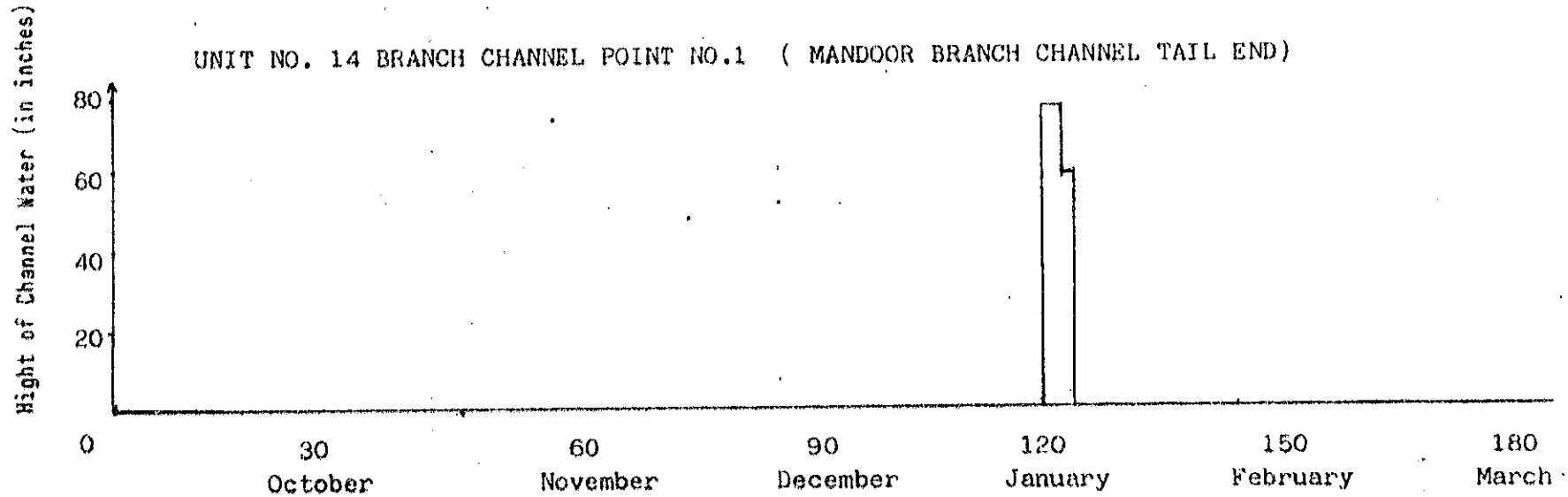
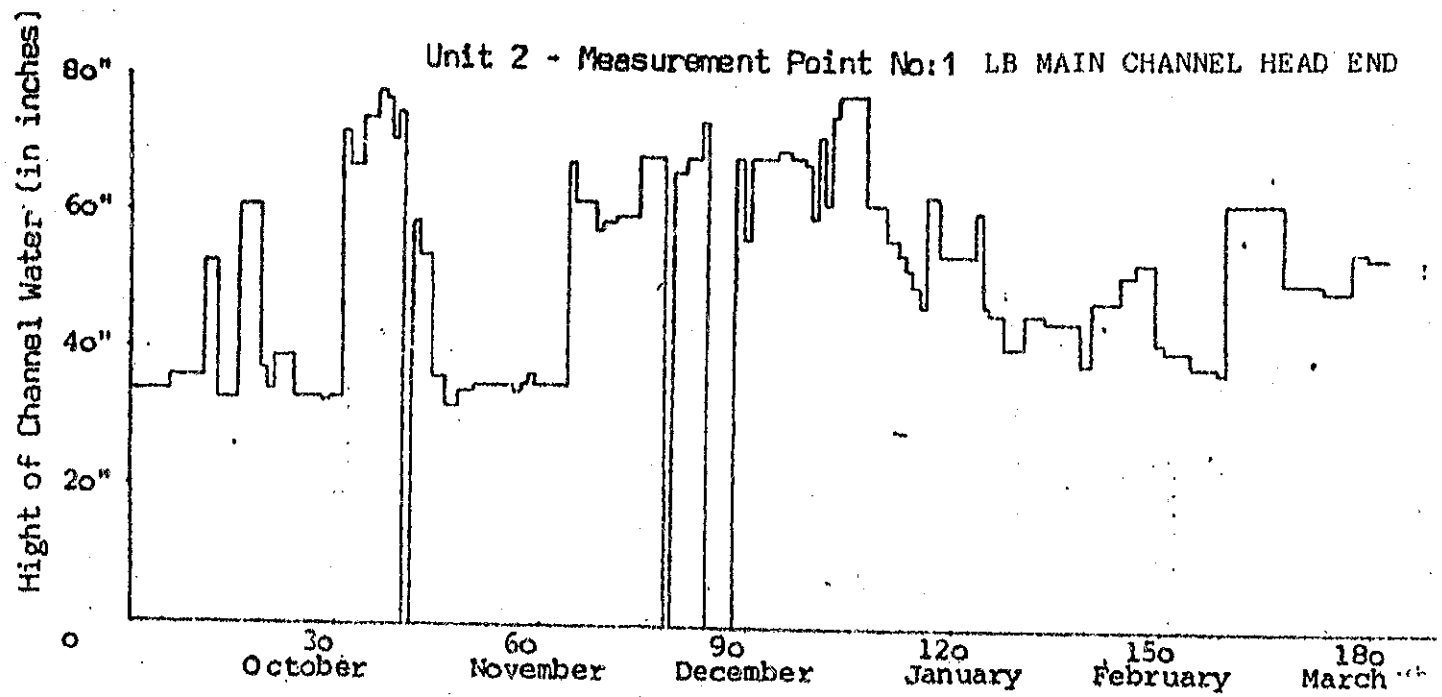


Figure 3.3.a, Water flow chart 79/80 Maha.



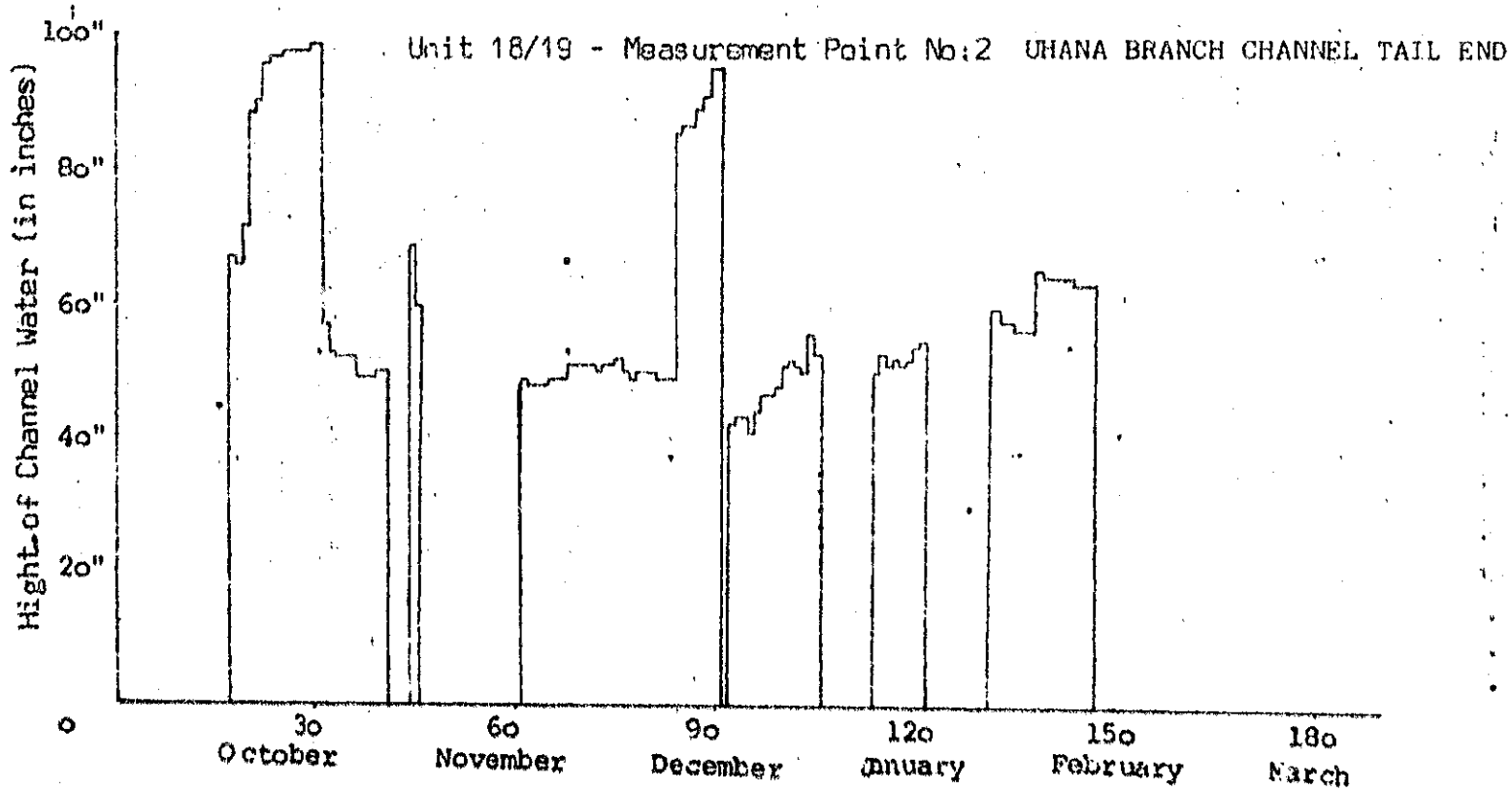


Figure 3.3.b,
Water flow chart
84/85 Maha.

3.3.3. Drainage Flow and Re-use:-

Prior to the rehabilitation project Drainage problems were observed in upper portions of certain channels where over-irrigation occured, and in portions of the tail end of some channels where drainage water from above accumulated. An indepth investigation into the drainage flow were not attempted at the planning stages of the project. In addition, the re-use patterns or the feasibility of recycling etc. have not been studied. The master plan, however, had recognized the drainage problems in the costal area. The report describes the effects of tidal fluctuation on drainage capacity as follows:

"..... the costal currents which effectively close most of the dry season drainage outlets would require study to develop any variable means of keeping open the drainage outlets. Variations in water depth as little as 10 cm. can flood out and damage rice in the coastal plains" (section II p. 30).

The master plan reports that the benefits to be derived from increased production in the affected areas do not appear to be able to support the high cost of drainage. Alternatively, investments on increasing productivity elsewhere in the project area were thought to be more beneficial.

The influence of rehabilitation and improvements in water management on the drainage flow - especially on farms depend on the drainage flow - was being considered as minimal. (Final Evaluation of Sri Lanka Water Management Project, No. 383-0057, International Science and Technology Institute Inc. 1985).

However, the evidence of the project's impact on drainage farms is inconclusive to date. For example, during the severe water shortage experienced during 1981 dry season,

water savings by field channel groups in one location has led to a reduction in the drainage (out flow) and consequently the 'unauthorized drainage farmers' had to face water shortages. In such cases water saving techniques like rotational deliveries adopted by field channel groups were discontinued due to non-cooperation and intervention by drainage farmers.

Chapter IV

AGRICULTURAL PRODUCTION

The most proximate objective of the project was to raise production by some combination of the following:

(a) increased output per acre, with yields raised because (1) water was provided more adequately and in a timely manner, and/or (2) the more reliable water supply plus government promotion led to changes in agricultural practices that boosted production.

(b) increased extent cultivated, both within the Left Bank system as a whole and within specific channel networks, due to (1) better distribution of water within the main system, and/or (2) better water use efficiency within field channels and farmers' fields.[1]

The physical rehabilitation assessed in Chapter 1 and the farmer organizations treated in Chapter 2, if coupled with improved main system management by the Irrigation Department would have lead to a better water supply to farmers (Chapter 3). This, if accompanied by appropriate non-water inputs would lead to greater

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1. A possible third means would have been to convert acreage particularly in yala season to subsidiary crops which might save water through reduced water requirements, possibly permitting increased area of cultivation or increasing output per acre. But by the end of project, there was no significant development of such production of chillies, cowpea, green gram, etc. Indeed, with good water supply in yala 1986, the modest level planted to such crops in yala 1985 appears to have been reduced. As noted below, the problem for farmers in changing to such crops lies not just on the input and marketing side but on coordination of the Agriculture Department with Irrigation Department to achieve timely and efficient water deliveries for such crops.

output. As this area is devoted almost entirely to paddy paddy production, we will be concerned with it in this chapter.

Production can be increased by redistributing water within a system like the Left Bank or within a channel command area if there is overuse of water in head-end reaches, such that tail-end areas can raise their output if given more water while production is not decreased in head-end areas where it was going to waste[2]. Thus considering distribution and differentials is relevant for consideration of production and productivity.

Changes in Yield

It has proved very difficult to establish a clear trend in paddy production on the Left Bank. The evaluation team sponsored by USAID after examining official government data for the period 1979-85 and also the detailed ARTI data from its baseline study and farmer record-keeping exercise felt it was not able to say conclusively that there was an increase, though some higher average yields are reported in the later years. Even in irrigated areas production remains greatly influenced by variations in rainfall and climate. It is a myth that irrigation gives man control over his environment. It can compensate for environmental conditions but cannot eliminate them. For example, in two of the seasons under consideration, yield and production were badly affected by flooding in what is called the 'Dry Zone', As if this is not enough of a problem, there can be pest attacks

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2. Indeed, if water was being over-used at the head, it might even have depressed yields somewhat, and reducing use could raise them. However, for individual farmers at the head, the former situation could have been more profitable if they saved all costs of weeding thereby. Assessments of yield should not be equated with conclusions about profitability.

which cancel out all or most of the benefits of irrigation, as in 1979/80 Maha season when there were disastrous brown hopper infestations.

All this makes evaluating irrigation's impact on yields and production ambiguous. To make reliable comparisons of pre-and-post-project levels, one should have at least three-year averages before and after a project and preferably five-year averages. ARTI carried out a 'baseline' study for the Gal Oya project in the 1979/80 Maha season. For the reason given above, the yields in this year (34 bushels per acre) were extremely low, and taking this as the 'baseline' the project could not fail to register a substantial improvement and be a 'success'.

However, yields in the next Yala with favourable weather conditions were very good (57 bushels per acre) in the limited area where Yala crop was planted. In terms of yield, there was not much room for improvement simply by improving water supply. Gains would have to come mostly from non-irrigation sources. It would be hard for a 'water management' project to show a great deal of 'success' with this baseline.

In its published baseline report, ARTI identified the 'average' pre-project yield in the Left Bank of Gal Oya as 44.5 bushels per acre[3]. This was based on supervised crop-cuttings on a sample of over 500 farms distributed in the head, middle and tail of the system at the end of four seasons (1979/80 Maha, 1980 Yala, 1980/81 Maha and 1981 Yala). The size of the sample was reduced in subsequent years due to financial limitations but the sample farm remained the same and the yield figures in Table 4.1 are thus comparable. They show average yields during the last three seasons (1984 Yala, 1984/85 Maha and 1985 Yala) about 60 bushels per acre. Of course, as shown also

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3. 1980 Year Book for Sri Lanka Water Management Research ARTI, 1982, p. 44.

in Table 4.1, the level of water available for irrigation from the main reservoir was also more adequate at the end of the project than when it began. There is a modest correlation between yield and reservoir levels during the life of the project, .20 for Maha seasons and .43 for Yala. But this relationship explains at most 20% of the variance in yield. Other factors are also involved, including how well the water is distributed, what rainfall there is (and how well it is distributed), inputs, pests, etc.

Table 4.1 . Average Yields in Gal Oya Left Bank, by Season, and Reservoir Supply at Start of Season

	Yield bushels/acre	Reservoir Level (acre-feet)	% of Capacity*
1979/80 Maha	34 (pest attack)	390,429	
1980 Yala	57	368,100	48
1980/81	48	107,700	
1981 Yala	38	186,125	24
1981/82 Maha	62	109,575	
1982 Yala	59	151,100	20
1982/83 Maha	64	720,000	
1983 Yala	53	315,250	41
1983/84 Maha	45 (flooding)	28,670	
1984 Yala	59	768,000	99
1984/85 Maha	60	486,000	63
1985 Yala	60	552,000	72
1985/86 Maha	56 (flooding)		

*770,000 acre-feet

Sources - 1980 Year Book, op. cit.; and Seasonal Reports prepared by ARTI on basis of Record-Keeping Programme.

It appears that yield levels have increased from about 45 bushels per acre in the Left Bank to about 60 bushels per acre now, barring natural calamities. (Despite flooding during the latter part of 1985/86 Maha season, average yield in this season was 56 bushels per acre). Over two-thirds of the farmers interviewed in a random sample within the Left Bank area at the end of the project were of the opinion that paddy yields have increased compared to 1980, as reported in Chapter 4. This supports the record-keeping data which suggest an increased yield level of as much as one-third.

Cropping Intensity

When the project was planned and when ARTI initially set criteria for evaluation of project impact, 'cropping intensity' as the combined pe centage of Left Bank command area cultivated both Maha and Yala seasons, was an obvious indicator. While no precise figures were available, field investigators suggested that about one-third of the Left Bank was seldom cultivated in the Yala season, to the extent that field channels have often been ploughed up to gain more area for rainfed cultivation. Even in head-end areas, 10 to 15% of the command area was not cultivated in Yala because of difficulties in getting water to the tail of long distributary channels. In the middle reaches, this figure reached 20 to 25% (the lower 40% of the 2,500 acre command area of M 5 was usually not cultivated in Yala). Cropping intensity was probably about 150%, though when authorized Yala planting was restricted to 12,000 or 18,000 acres on the Left Bank, this brought the cropping intensity down to 120 to 13% in water short-years.

Fortunately for Gal Oya Left Bank farmers, but unfortunately for project evaluators, the last two years have not been water-constrained and the full extent of the Left Bank practically speaking has been cultivated in Yala season. Cropping intensity

can only be judged with representative data from Yala season, so we would not present the statistics for the last two years, with cropping intensity approaching 200% as attributable as such to project 'success'. The data in Table 4.1 on 1984 and 1985 Yala water supply make any calculation and presentation of cropping intensity statistics not meaningful. The data and discussion in the preceeding section, however, give some basis for expecting that the water management capacity is in place to achieve nearly maximum cropping intensity within a particular years' supply constraints.

Agricultural Inputs and Practices

Aggregate comparisons of cost of production over time are very difficult to make. The average cost of production per acre in 1979/80 was 1274 rupees (1980 Yearbook, op.cit., p. 36) compared to a range of 2565 to 3095 rupees per acre in 1985 according to ARTI's farmer record-keeping data. The main problem with general comparisons comes from trying adjust for changes in price over the five-year period. The Consumer Price Index is not an appropriate deflator for agricultural costs of production. Also there are continuing disagreements among economists as to how family (or exchange) labour inputs should be valued in such an exercise, at market wage rates, at shadow wage rates, at opportunity cost estimates, etc. We have opted for some specific comparisons where data can be more definitely determined and assessed.

Fertilizer and Agro-Chemicals: The inputs of most interest in terms of 'modernized' agricultural practices are the use of fertilizer and of weedicides, insecticides and other agricultural chemicals (such as fungicides). Cost of production data for a representative sample of Left Bank farmers in 1979/80 showed per acre expenditure on fertilizer of 100 rupees and on agro-chemicals of 107 rupees (46 rupees on weedicides and 61 rupees

on other chemicals). Average per acre expenditures on fertilizer five years later were 361 rupees in Maha and 363 rupees in Yala, along with 262 rupees on agro-chemicals in Maha and 250 rupees on them in Yala. Such figures, of course, need to be adjusted for changes in the price of fertilizer and chemicals between 1980 and 1985. An analysis of quantity and price data from the original codesheets shows a weighted average increase in fertilizer prices of 2.9 times for this period, and an increase of almost exactly 3 times for agro-chemicals.

Using such deflators, we estimate that average per acre fertilizer use has increased over the five-year life-of-project by 24% in Maha season and by 32% in Yala. On the other hand, average use of agro-chemicals has decreased by 18% in Maha and by 22% in Yala. Reasons for the latter can be several; lack of supply, lack ofincome or credit (demand), inefficiency, etc. We cannot determine the relative importance of such reasons, but it is significant to note such decreases in use of agro-chemicals, especially at the same time fertilizer use has gone up[4].

Levels of fertilizer use can be assessed relative to recommendations given by the Department of Agriculture for application in Ampara District: VI (basal) 75 Kg/acre; TDM (top-dressing) 50 Kg/acre; and urea 37.5 Kg/acre, for a total of 162.5 Kg/acre. The Left Bank average for the last four

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4. We are not commenting on questions of health and safety in the use of agro-chemicals which deserve consideration in their own right apart from any relation to agricultural production. We note that since the project ended, the Department of Agriculture with FAO support is introducing an Integrated Pest Management Programme on Experimental basis to determine how yields can be increased with a minimum of chemical inputs.

seasons has been quite stable, varying between 153.2 Kg/acre in 1983/84 Maha and 142.3 Kg/acre in 1984/85 Maha, with the 1984 and 1985 Yala seasons totalling 145.8 and 146.2 Kg/acre respectively. According to type of fertilizer, Left Bank farmers are applying very close to the recommended level of TDM -- 50.3 Kg/acre the past four seasons, but then only about two-thirds the recommended level of VI -- 49.6 Kg/acre and about one-third more than the recommended level of urea -- 48.1 Kg/acre.

These levels are fairly constant throughout the Left Bank, though there is some fall-off toward the tail. The total level of nutrients applied on average for the past four seasons at the head is 153 Kg/acre, with 146.5 Kg/acre in the middle reaches, and 140.4 Kg/acre in the tail units. We noted above that the end-of-project levels of fertilizer use were about one-quarter higher than in the baseline year of 1980. However, from our farm record-keeping data, we do not detect any upward trend during the past four seasons. It appears that increased use of fertilizer has 'stalled', though we cannot say whether it is due to supply or demand constraints. Farmers frequently identify the lack of institutional credit and the exorbitant cost of private credit as a factor limiting their use of fertilizer.

Choice of Varieties and Planting: During the life-of-project, there has been a notable shift in the kind of paddy varieties planted and in the coordination of cultivation. The baseline study found significant staggering of dates for land preparation, planting and harvesting, with the elapsed period greatest within head-end units, where water availability even under a loosely-managed system was greatest, and least in tail-end units depending largely on rainfall. There was no significant pattern of staggering within or between field channel areas. (1980 Yearbook, op. cit., p. 51).

With less discipline and coordination in crop operations, there was also less homogeneity in varieties planted and in their length of maturation, though there was already widespread use of improved paddy varieties. In 1980 Yala and 1980/81 Maha, half; to two-thirds of LB farmers used 3-3½ month varieties as seen in Table 4.2, and substantial numbers planted longer-maturing varieties. At the same staggering of planting has been reduced from about 6 weeks in Yala to about 4 weeks, with comparable change also for Maha, the varieties planted have shifted overwhelmingly to 3-3½ month type. Indeed, BG 94.1 was planted by 75% of farmers in last Maha and 78% in the last Yala season.

Table 4.2 : Adoption of Paddy Varieties (% of farmers)

Age Category	1980 Yala[5]	1980/81 Maha	1984/85 Maha	1985 Yala
3 months	21	14	2	5
3½ months	48	69	79	87
4 months	18	21	8	3
Mixture	13	6	10	5

Lessons Learned

Various things can be observed from the experience with the Gal Oya project over the last five years. They can be summerized as follows:

1. Establishing a 'baseline' or an 'endpoint' for irrigated production is difficult: Although irrigation is supposed to offset or eliminate the effects of

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5. Average for head and middle farmers only, as no Yala crop was planted by tail-end farmers in our record-keeping programme.

weather, these are everpresent, so that there are few 'normal' years. While water scarcity has been the most common problem in Gal Oya, occasionally flooding has cut into yields as badly as drought. Trendlines need to be drawn over a fairly long period.

2. Yields in Left Bank Gal Oya appear to have increased according to data and farmers' accounts, but improving water distribution is not enough: The average yields of about 50 bushels per acre are still far below the 100-110 bushels per acre attainable with good practices and modern inputs. The benefits of the physical rehabilitation and farmer organization-cum- water management efforts will not be adequately achieved without further gains in the area of extension, inputs, credit and marketing.

3. The main gains in production from water management improvements will come from main system management, more than at field channel level: The differences in yield between the head and tail of field channels were not very great even before the project. Average yields in 1979/80 Maha were 35.6 bushels per acre on farms at the head of field channels compared to 35.6 bushels per acre on farms at the tail, according to the 1980 Yearbook (p. 21).[6] Thus the main improvements have resulted from better water control within D-channel areas and within and between sub-systems.

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6. This figure for the tail-end does not take into account uncultivated acreage at the end of field channels due to inadequate water management upstream, it should be noted.

4. <u>Development of agricultural production and more efficient water use through growing subsidiary crops must be closely coordinated with irrigation:</u> Efforts to promote production of chillies, cowpeas, greengram, etc. have been based on individual farmers' willingness to grow these crops, with offer of subsidy or guaranteed price. Delivering water to scattered locations within the Left Bank after the close of deliveries for paddy can be very inefficient.[7] Whereas Irrigation Department staff have come to think much more in 'agricultural' terms now than was evident at the start of the project, Agriculture Department staff now need to think more in terms of 'irrigation'. The ID could identify blocks of land it could serve efficiently after the close of the paddy season and farmer organizations could be invited to commit such blocks of land to subsidiary crop production for efficient water use.

5. <u>Credit remains a definite constraint on improved production</u>: The stalling in increase of fertilizer use and the decline in agrochemical apllication may be due in part to supply constraints, but there appears to be enough supply, through private channels if not through public/institutional ones. The demand side is the more likely explanation. ARTI has done a special study on credit in the Left Bank. It found that commercial/institutional credit from the banks

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7. In one instance, where water had to be gotten to a 15 acre area planted to chillies in 1985 Yala, 500 cusecs had to be released because the D-channel serving the area went off from the upper Left Bank main canal, which has a capacity of 1500 cusecs at that point.

and cooperatives accounts for only 32% of the number of loans taken by Left Bank farmers on the average, and 38% of the amount of loans, where as private 'non-institutional' sources account for 50% of the loans, and 37% of the value.

Interest rates of such range up to 20-25% per month.[8] Between 60 and 80% of Left Bank farmers are currently ineligible for institutional loans because of their past credit history. Gal Oya farmer organizations have earnestly sought a 'new start' with the formal credit system, even offering time-payment proposals for back debts to re-establish creditworthiness. But so far there has been no response from the institutional credit sector.

6. Seed paddy is unlikely to be adequately supplied through the institutional sector: The government's seed multiplication and certification programme meets less than 10% of farmers' needs, and farmers now rely on one another for seed, i.e. on enterprising farmers within their own community. This of course has the danger that farmers will be getting inferior seed stock. Perhaps a 10% further increase in production could be obtained by the government supplying quality foundation seed to farmers growing seed paddy. To ensure good distribution of seed paddy and fair pricing, the assignment of foundation seed could be made through the farmer organizations, which would have an active interest in overseeing quality and timeliness of seed production.

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8. Data from Gamini Wickramasinghe, Agricultural Credit in Gal Oya, ARTI, draft, 1986. Non-commercial loans, i.e. from friends or relatives with no interest charged, made up 18% of loans and 25% of the total amount of loans taken by LB farmers.

7. Marketing remains perhaps the most visible constraint on incentives for increasing production: What was before an undesirable situation for farmers, in terms of price and terms of sale, has become a deterrent with the changes made in the marketing system due to the worsening security situation in the district. We do not want to make any recommendations in this area, having made no systematic study on marketing. But we have heard enough complaints, many acknowledged by the PMB, that if the government is serious about raising paddy production in the Left Bank, it would solicit farmers' experience and problems in paddy marketing and would investigate them together with the PMB. The farmer organizations already have some suggestions on how the situation could be improved, such as having the organizations themselves become the PMB 'buying agents' to ensure fair prices.

8. Reducing staggering still further will depend on coordination of inputs: A first tightening of the cultivation calander has been made, as farmers have gained confidence in the ID's delivery of water and as farmer organizations and government officials have stepped up pressure on farmers to meet agreed deadliness. A further tightening will require some alleviation of draught power constraints, and will be assisted by farmer organization efforts to purchase and provide fertilizer and other inputs in bulk for whole field channel or b-channel areas, with delivery at a certain time, when farmers should be ready to use them.

9. The use of agrochemicals should be carefully considered: Many complaints have been received from farmers about the quality or efficacy or weedicides, insecticides, etc. which we are not in a position to evaluate. There is some apparent loss of confidence among at least

some farmers in agrochemicals, and there is a growing awareness of health hazards. The FAO-assisted programme for Integrated Pest Management noted above is thus timely and appropriate. Some use of chemicals will certainly continue to be needed and productive. But it does not appear correct to assume that increased use of agrochemicals will in itself represent or ensure progress toward project goals.[9]

10. Extension advice can probably be most readily diffused now through farmer organizations: As seen in the next chapter, extension advice is the only public service on which there is a strong consensus about improvement. Still, it appears that recent personnel constraints have reduced some of the effectiveness of the extension effort. The most efficient way of reaching farmers is through organized rather than individual channels. KVSs and AIs have already begun working through farmer organizations at different levels, and their efforts have been appreciated and have had some impact. But a more systematic extension effort through farmer organizations remains to be made.

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9. We note that at the Ampara District Agriculture Committee meeting when the FAO programme was announced (April 30), it was warmly welcomed by the Members of Parliament attending, because of their own concerns and those of the public which they expressed.

Chapter V

COST AND BENEFITS OF GAL OYA WATER MANAGEMENT PROJECT

This section presents an economic appraisal of the Gal Oya Water Management Project using conventional cost-benefit analysis. The USAid Project Paper recognized the importance of economic viability of the project and commented that "it should command high priority on economic grounds" (1979 : p40). It estimated an Internal Rate of Return (IRR) of 23% based on available data and judgements relating to the future values of certain parameters such as cropping intensity, yields and prices. However, the actual performance and behaviour of these parameters over the last five years have been different from what was predicted. The projection of future benefits is usually subject to a wider margin of error than estimates of costs. The most important aspect of project formulation, therefore, is the preparation of an estimate of project net benefits based on 'realistic' assumptions. The difficulties are greater when estimating future benefits from agricultural output within a project area. The expected benefits take place over a long period, and predicting the growth of crop yield which depends on many uncontrollable factors as well as one the adoption of anticipated agricultural practices is most difficult.

While recognizing the difficulties in predicting certain variables such as the storage level of the reservoir, water management practices, and particularly farmer responses to the changing hydrologic and socio-economic environment in Gal Oya Left Bank, the present analysis attempts to estimate the future cost and benefits on the basis of already achieved levels and observed trends in certain parameters such as cropping intensity, yiela, and prices.

Although somewhat delayed, the Gal Oya Project activities began in 1979/80 with socio-economic research (1979) and surveying work related to rehabilitation (1980). Design and construction work, training of personnel and on-farm water management efforts began only in 1981. Thus the actual benefits resulting from the modernization of the physical system and water management could not be expected from the year 1980/81. On the other hand, project activities could not be completed as planned

originally, and only about 95% of the overall project activities and 86% of rehabilitation construction work had been completed by the end of December 1985. Thus, it is more likely that the physical rehabilitation and water management efforts will continue through 1986.

As in the Project Paper this section follows the same scheme and has been organized into three sections.

(1) Land use and production benefits
(2) Evaluation of costs, and
(3) Rate of Return and Sensitivity analysis.

(1) Land Use and Production Benefits

One of the main constraints to increased food production in Sri Lanka is the unpredictability of monsoon rains and inadequate water for agriculture in the dry zone areas. Thus the provision of irrigation water and improved efficiency in water management are most central to any land development and settlement policies aiming at increased agricultural production and employment. The Gal Oya irrigation scheme which originally planned to fulfil some of these objectives had over a period of time faced a number of problems which restricted the full use of its potential. The most critical among them were the deterioration of the physical system and the resulting inefficiency in delivering adequate amounts of water to the paddy fields. There were many other associated problems as well: inability to cultivate a second crop during Yala season, especially in the tail-end parts of the Left Bank, subdivision of farm plots, low land productivity, increased unemployment and low incomes among farming families (see Wijayaratna et. al. 1982). Hence there was a great potential for increased paddy production resulting from improvements in the irrigation infrastructure and better water management. The USAID Project Paper anticipated that "by the end of life of the project a carefully designed, controlled and monitored water management program will have established the base for a highly productive and energized system of agriculture which will serve as a moderl for the res of the country" (p.42).

There are no reliable estimates of the total acreage under paddy cultivation in the Left Bank of Gal Oya. It is generally known that more land than the amount originally allocated to settler families has been cultivated by those encroaching on reservations and the drainage parts of the system. It is also difficult to notice any consistency in the estimates of various government departments. The project paper has taken a figure of 52,000 acres to be under rice cultivation, and of this total, about 7,000 acres are estimated to be encroached land[1]. Based on the assumption that this entire total acreage is cultivated during Maha season and only about 15,000 acres would be cultivated during Yala - a cropping intensity of 129% was calculated for Left Bank before the Modernization Programme began. However, the average area under cultivation during Yala season could be more than 15,000 acres. The area authorized by the Irrigation Department for Yala irrigation during the pre-project period 1974-1981 averaged about 17,600 acres, though the actual acreage varied from year to year according to the storage level in the reservoir. Since these figures do not account for the encroached lands, the actual area under cultivation during any given season could be more than the authorized area (see Murray-Rust, 1983 : 149-168). Hence it would be reasonable to assume an average of at least 18,000 acres as the dry season cultivated acreage. The area under cultivation during Maha season is also generally higher than the Project Paper estimate. The Mid-Term Impact Assessment Report has estimated that this could be around 62,000 acres (ARTI, 1985 : 66-67). The 1980 Year Book guesses a figure of about 65,000 acres. As no accurate record of the cultivated area is available, the following estimates of cropping intensities are based on the ID figures on irrigated area adjusted for unauthorized cultivation of encroached lands.

The project paper assumed that the Gal Oya modernization projects will yield benefits for at least 20 years. Based on this, it estimated the agricultural production under 'with' and 'without' project situations.

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1. These estimates were based on the information available from the Ministry of Agricultural Development and Research and the Ministry of Lands and Land Development.

The following Table 1, gives the estimated paddy production in Gal Oya assuming a 'without' project situation based on the acreage figures provided by the ID and the average yield estimates taken from the proejct paper. It is assumed that almost entire area is cultivated during Maha and an average of 18,000 acres are cultivated during Yala. Since proejct activities began only in mid-1980, and rehabilitation and water management efforts began even later, the crop year 1980/81 can be taken as the year 1. As in the project paper, paddy yields are assumed to increase at an annual rate of 1% per year and the cropping intensity remaining unchanged at 1980/81 level. Thus the annual production would increase from approximately 3.383 million bushels in year 1 to 4.085 million bushels in the 20th year.

Table 5.1

Paddy Production in Left Bank Gal Oya Without Projwct

Year	Gross Sown Acreage	Average Yield(bu/ac)	Production[a] (1000 bu)
1	79,800	52.5	3,383
2	79.800	53.0	3,415
3	79,800	53.5	3,447
4	79,800	54.06	3,484
5	79,800	54.6	3,518
6-20	79,800	55.15 to 63.4	3,55404,085

(a) Since yield figures have been calculated on a net harvested acreage basis, total production is calculated multiplying yield by net harvested acreage. Net harvested acreage is estimated using the following conversion factors taken from the Project Paper:

Gross harvested acreage - 95% of gross sown acreage
Net harvested acreage - 85% of gross harvested acreage
Net harvested acreage - Gross Sown Acreage x 80.75%

The estimated annual production of paddy given in Table 5.1 is slightly higher than the Project Paper estimates. This is due to the assumed higher acreage under cultivation.

According to the Project Paper the economic benefits of the modernization project measured in terms of increased paddy production appear only in the 3rd year of the project. It was envisaged that from the 3rd year, 5,000 acres of new land would be brought under irrigation at an annual rate of 1,000 acres. With improved water management and efficient control of the water delivery system it was also expected to increase the land under irrigation during the dry (Yala) season. On this basis it projected a rapid increase in the cropping intensity from 129% in the 3rd year to 189% by the 8th year and remain constant there after. Availability of adequate water well as improved on-farm water management practices would induce farmers to increase their efforts to improve agricultural productivity. Therefore the Project Paper predicted a considerable improvement in the average yield per acre. For instance, the yield would increase from 55 bushels in the 4th year at 7% per annum to 62.5 bushels per acre in the 7th year and then gradually increasing further at a decreasing rate to 82.4 bushels per acre by the 20th year.

These projections can now be compared with the actual performace in the Left Bank during the past five years. Considerable differences can be noticed between the Project Paper estimates and the realized figures (Table 2). The most apparent are in the average yield per acre, area under cultivation, and resulting increase in the total production. The actual yield data do not establish any consistent pattern considerably higher than the projected estimates. The absence of a clear trend over the period partly reflects the diversity of various factors that affect productivity and thus result in wide variations from season to season. This may conceal the effect of improved water availability, input use and cultivation practices on productivity. However, the classification of yield data into locational categories of head, middle, and tail bears out certain trends to some extent. It shows that there is a slight upward trend in productivity as well as a reduction in the head-tail differentials (see Final Impact Evaluaton Study).

The increase in the area under cultivation during Yala 1985 is more remarkable than that in 1984. Two main factors have contributed to this increase : (a) the increase supply of water in Senanayaka Samudra, and (b) better operational practices and improved on-farm water management.

The effect of this second factor was clearly seen in Yala 1985[2]. Although the storage level during this season was well below the full capacity reached in Yala 1984, the area under cultivaion increased substantially more than achieved in 1984 (see PRC/EC, Quarterly Report No.21:41). With the expected completion of physical rehabilitation work in 1986, it is more likely that water management efforts and operational practices will improve further. Yet, it is difficult to envisage that the normal Yala acreage under cultivation in future would be higher than the figure reached in 1985. The storage level in Senanayake Samudra rarely reaches full capacity or even 500,000 acre feet, and the average level during Yala in most years has been well below 400,000 acre feet (see Murray-Rust, 1983 : 90-91). Thus, even if water saving measures through better operational practices become successful, the main constraint to higher cropping intensity would be the average low level of water in the reservoir.

The projections given in Table 3 are based on the trends observed for the past several years and on the likely behabiour of farmers increasing their efforts and investments in paddy agriculture under conditions of improved water availability. Thus, the cropping intensity based on the expected average level of water in the storage tank and on increased efficiency in water managemetn practices, is assumed to be 165% from the 6th year onwards. This means that the area under cultivation during Yala would be about 40,000 acres. Given the fact that the average storage level during Yala has been about 380,000 acre feet for the period 1969-85, irrigating 40,000 acres of paddy in the Left Bank will not be an extremely difficult task with improved water management practices. For example, during Yala 1985 the Senanayake Samudra with a storage level of 551,760 acre feet had released 323,545 acre feet to cultivate 87,950 acres of paddy in the entire command area. This amounts to a very low water duty of 3.68 acre feet per acre. Much of this released water (about 73%) was used to irrigate over 40,000 acres in the Left Bank (Godaliyadda, 1986).

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2. It has been reported that during Yala 1985, over 40,000 acres in the Left Bank were irrigated with a low water duty of 5.15 acre feet (Godaliyadda, 1985).

The average annual yield is expected to increase from the present level of 60.5 bushels to 94.5 bushels in the 15th year and remain constant thereafter. This would be a modest target under present conditions and in the context of already achieved high levels during the arly stages of rehabilitation work in Gal Oya LB. For instance, 1980/81 Maha season recorded the highest average of 70 bushels, and 1980 Yala recorded 67 bushels. Similarly the highest average for middle and tail-end area of the system has been 77 bushels in Yala 1980, and 67 bushels in 1980/81 Maha respectively[3]. Thus, it is reasonable to assume an increase of 5% for the 6th year, 7% for the 7th, and 10% for the 8th year. Thereafter the average annual yield is predicted to increase at the following annual rates : 8%, 5%, 4%, 3%, 2%, 1%, 1% respectively. The annual production would thus increase from 4.0 million bushels in year 1 to 7.783 million bushels int he year 20.

Table 5.3

Paddy Production in Gal Oya - Left Bank with Project.

Year	Irrigable Paddy (Acres)	Gross Sown Area (Acres)	Cropping Intensity %	Net Harvested Area(Acres)	Average Yield bushels(ac)	Production (000 bushels)
1	61,800	74,800	121	60,401	59.5	4,007
2	61,800	74,800	121	60,401	57.0	3,404
3	61,800	79,800	129	64,433	57.3	3,880
4	61,800	92,400	149	74,612	52.1	3.716
5	62,000	108.500	175	87.614	60.5	5,292
6	"	102,000	165	82,365	63.5	5,230
7	"	1[illegible],000	165	82,365	68.0	5,601
8	"	102,000	165	82,365	74.8	6,161
9-20	"	102,000	165	82,365	80.8-94.5	6,655-7,783

(a) For the years 1-5 estimated actual figures are given.

3. The average annual yield per acre estimated for Ampara District by the Census and Statistics Department is more than 80 bushels for the period 1980-85.

The estimates of production streams under 'with' and 'without' project situation given in Tables 5.1 and 5.3 have been used to calculate the incremental benefits over the 20 year period. The incremental benefits as illustrated in Table 4 appear to be substantial. In terms of land useuse, 22,200 additional acres would be brought under irrigation by the 7th year as a result of increased cropping intensity. The combined effect of increased cropping intensity and yield per acre results in the production of additional 3.693 million bushels of paddy by the year 20.

Table 5.4

Re-Estimated Incremental Benefits Compared to Project Paper

Year	Incremental Acreage	Incremental Production (bu 1000)	Incremental Gross[a] Benefits (Rs.1000) (Bushel Rs. 74.17)
1	-	624	46,282
2	-	-11	-816
3	-	433	32,116
4	12,600	232	17,207
5	28,700	1,774	131,578
6	22,200	1,676	124,309
7	22,200	2,012	149,230
8	22,200	2,533	187,873
9-20	22,200	2,995-3,698	222,139-274,281

(a) Price per bushel of paddy is based on import price of rice. The price of imported rice has been (per metric ton) as follows: 1980=Rs.4,530: 1981=Rs.5,953: 1982=Rs.5,116 1983=Rs.4,915: 1984=Rs.4,876: Average 1980-84=Rs.5,078 Rice/Paddy conversion ratio: 1 mt. ton rice=68.46 bushels of paddy: price of a bushel=Rs.74.17.

In order to estimate the benefits accruing to the economy in terms of reduced imports of rice, the incremental production has been valued at the estimated import price of paddy (see footnote in Table 5.4). This results in an incremental value of Rs.274.3 million in the 20th year.

Table 5.2 Paddy Production in Gal Oya Left Bank 1980-1985

Crop Year	Area Irrigated for Cultivation		Gross Sown Acreage		Cropping Intensity (b)		Yield per Acre		Production (1000 bushels)	
	Maha[a]	Yala	Projected[b]	Actual	Projected	Actual	Projected[b]	Actual	Projected[b]	Actual[c]
1980-81	61,800	13,000	67,000	74,800	129	121	52.5	59.5	2,840	4,007
1981-82	61,800	13,000	67,000	74,800	129	121	53.0	57.0	2,867	3,404
1982-83	61,800	18,000	73,700	79,800	139	129	53.5	57.3	3,183	3,880
1983-84	61,800	30,600	81,000	92,400	150	149	54.0	52.1	3,532	3,716
1984-85	62,000	46,500	89,100	108,500	162	175	55.6	60.5	4,000	5,292

(a) It is assumed that the Maha Seasons during which there is adequate water supply, the entire asweddumized area (62,000) or a very large part of it is cultivated.

(b) Project Paper - Table 111-3 (p.45)

(c) Actual Production calculated separately for Maha and Yala seasons by multiplying each season's net harvested acreage by the average yield for each season.

(2) Evaluation of Costs

Three types of costs will have to be taken into account when evaluating the cost to the economy.

(a) Capital Costs
(b) Operating and maintenance costs
(c) Production costs.

(a) Capital Costs.

The Government of Sri Lanka and USAID provided the necessary capital for the Gal Oya Left Bank modernization and water management project. The USAID component included a loan of US$ 8,800 million at 2% interest per annum during the grace period and at 3% per annum thereafter, and a grant of US$ 4.8 million[4]. The GSL contribution was originally estimated to be Rs. 132.57 million. (46.6% of total estimated costs) Both USAID and GSL contributions appeared to have been revised and increased during the period 1980-85. The capital costs included in Table 5.5 have been derived from the actual expenditure given in the PRC Quarterly Reports.

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(4) These figures are higher than the estimates given in the Project Paper, i.e, a loan of US$ 6.8 million and a grant of US$ 3.0 million.

Table 5.5

Capital Costs - L.B. Gal Oya.

	Year	USAID(Loan+Grant) (Rs.000)	GSL (Rs.000)	Total (Rs.000)
(1)	1980/81	68.203.2	14.199.5	82.402.7
(2)	1982	43,471.5	20,209.8	63.681.3
(3)	1983	32,875.0	52,121.8	84,996.8
(4)	1984	51,929.3	54,898.8	106,828.1
(5)	1985	86.103.0[a]	69,020.0*	155.123
(6)	1986	-	10,000.0*	10.000.0
(7)	1987-2000	-	-	-
				503,031.9

* Allocated amounts for 1985 and 1986 excluding non-Gal Oya items.

(a) By Dec.31, 1985, only US$ 7.456 million of the loan and US$ 4,192 of the grant were utilized out of a total authorized amount of US$ 8.8 million, and US$ 4.8 million respectively. Inquiries from the PRC office revealed that the actual expenditure would be higher than these figures. Accordingly it is assumed here that approximately US$ 1.0 million has not been utilized.

The estimates given in this table, however, excluded certain cost elements which are not directly relavant to the Gal Oya Project. For instance, of the GSL component, 50% of central support, 75% of GITI Training and 35% of master planning (which was related to Udawalawe Project) have been excluded.

The excluded amount relating to central support and GITI Training was based on a rough calculation of certain expenses which were related to non-Gal Oya costs and training. The excluded amount approximated Rs. 4.145 million. Similarly, from the AID loan, the ARTI expenditure on training, commodities and construction (total of US$ 0.192 million) and GITI commodities, and construction (US$ 0.067 million) have been excluded. A small amount of the grant component (i.e. 50% of special studies and pre-project studies) totalling US$ 0.315 million was also excluded.

The USAID dollar component has been converted into Sri Lankan rupees at the prevailing average exchange rate for each year. Since the Sri Lankan rupee was allowed to float, there was no need to find a shadow price for foreign exchange. [5] It is recognized that the excluded costs will largely benefit other irrigation schemes in Sri Lanka, the benefits from which could be difficult to assess and are not included here.

(b) Operation and Maintenance Costs.

This is the amount allocated by the Government to the Department of Irrigation as operation and maintenance cost on a per acre basis. The Project Paper assumed that this rate would be increased to Rs.125.00 in 1980 as requested by the iS. Assuming that this was paid, the total incremental O & M cost has been estimated for the 20 years project period.

This incremental cost has been calculated by multiplying the incremental acreage by O & M cost per acre. (see Table 5.6)

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(5) The Project Paper, however used a conversion ration of US$ 1.00 - Rs. 15.50. The actual exchange rate has been changing since then indicating a significant depreciation in the Sri Lankan Rupee: 1980=Rs.18.00; 1981=Rs.20.55; 1982=Rs.21.32; 1983=Rs.25.00; 1984=Rs.26.28; 1985=Rs.27.00 (approximate).

Table 5.6

Operation and Maintenance Cost

Year	Incremental Acreage	Total Incremental O & M Costs (100 Rs.)
1	-	-
2	-	-
3	-	-
4	12,600	1,575
5	28,700	3,588
6	22,200	2,775
7	22,200	2,775
8	22,200	2,775
9-20	22,200	2,775

(c) Production Costs

The Gal Oya farm record keeping data collected over the period 1979/80-1985 by the Agrarian Research & Training Institute have been used here to estimate the cost of production of paddy. The estimated annual average cost per bushel of paddy has been increasing over the years since 1979/80 from Rs.25.21 to Rs.53.76 in 1983/84 crop year. There was a slight decrease during the 1984/85 crop year to Rs.42.97 per bushel[6].

6. The breakdown of this cost into various input categories for the crop years 1979/80 and 1974/75 are as follows.

With increasing land productivity expected over the next few years, it is more likely that the production cost per bushel will decrease further. This, however, depends also on the rate of increase in the costs of various inputs over the period. Since the prices of both inputs and outputs are assumed to remain constant over the next 15 years, the projected cost of production per bushel of paddy is also taken to be constant at 1984/85 level. However, certain adjustment will have to the made in order to compare the farm production cost against the value of benefits from the point of view of the economy as a whole. Thus, two main inputs - labour and fertilizer - should be valued at their opportunity cost.

	Item	1979/80 Rs.	1984/85 Rs.
1.	Labour	11.66	15.90
2.	Agro-Chemicals	1.94	4.31
3.	Fertilizer	2.04	6.17
4.	Seed paddy	3.47	6.67
5.	Tractor power	2.71	4.00
6.	Animal power	2.95	3.70
7.	Other	0.44	1.13
	Total Cost/bu	25.21	42.97

It is extremely difficult to estimate the "true/ shadow wage rate of agricultural labour in an economy. In labour surplus economies, the marginal productivity of agricultural labour may be so close to zero as ti make zero a good approximation of the real value (Gittinger, 1972 : 42). However, in view of the fact that seasonal variations in the demand for agricultural labour often indicate shortage of labour during peak times, it is reasonable to assume a shadow wage not so close to zero. General observations indicate that real wages of unorganized agricultural and casual labour in Sri Lanka have improved over the past seven years. This suggests that there has been an increasing demand

for such categories of labour in areas especially where construction and wide variety of other activities are taking place. However, such off-farm work opportunities are not so readily available in the Left Bank, except perhaps in rehabilitation construction work sites and to a limited extent in the state-owned sugar plantation in the Right Bank.

Prior to the rehabilitation of the Left Bank only a small proportion (perhaps 30-40%) of the agricultural labour force could find gainful employment within paddy agriculture during Yala season. The proportion of these who had casula wage work within the area of outside as migrant workers in paddy farms or in off-farm activities such as construction work, trade, and fishing could not be very high. Much of the labour during Yala season would have been utilzied in marginally productive activities such as animal husbandry, handicrafts, petty trading etc. The opportunity cost of labour, therefore could not be very high. On the basis of these observations, the shadow wage rate is assumed to be equal to 50% of the market wage rate.

Since fertilizer was sold at a subsidized price, this needs an upward repricing to indicate the real cost to the economy. The fertilizer subsidy has been changing over the years from 50% to 70% during 1979-81 and then gradually declining to about 32% inSept. 1985(Fertilizer Corporation, also see Central Bank Annual Reports). Thus, for the remaining project period, the cost of fertilizer has been adjusted upward to reflect the actual value.

These adjustments lead to a reduction of labour cost by Rs.8.45 and to an increase of fertilizer cost by Rs.5.05 per bushel of paddy. The net result of these adjustments will be to decrease the cost of production by Rs.3.40 to Rs.39.57 per bushel. Estimates of cost of production per bushel for the years 1980-1985 have been based on actual costs adjusted for 'shadow' wage of labour and fertilizer subsidy rate for

each year[7]. The incremental production costs shown in Table 5.7 have been computed on the basis of these adjusted costs for the past five years and for the nex 15 years.

Table 5.7

Incremental Production Costs.

Year	Incremental Production (1000 bu)	Production Cost/per bushel	Incremental Production costs (Rs.1000)
		Rs.	
1	624	33.33	20,798
2	-11	53.02	- 583
3	433	47.06	20,377
4	232	45.21	10,489
5	1,774	39.57	70,197
6	1,676	39.57	66,319
7	2,012	39.57	79,615
8-20	2533-3698	39.57	100,231-146,330

(3) Rate of Return and Sensitivity Analysis

The economic viability of projects in general is judged by calculating the rate of return on capital invested. One of the most common measures used in proejct appraisal is the Internal Rate of Return (IRR) which "in a sense, represents the average earning power of the money used in the project over the project life" (Gittinger, 1972 : 71).

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7. For the years 1980/81 - 1984/85, the shadow wage differential was assumed to be 50% less than the market value. The fertilizer subisdy rate adjusted according to the actual subsidy for the past five years; 1979-81 = 75%; 1981-83 = 83%; 1983-85 = 45%.

Table 5.8 presents the streams of incremental gross benefits and gross costs taken from Tables 5.3 and 5.7 and the estimated incremental net benefit over the 20-year period. As can be expected the first 5 years during which heavy investment takes place, the incremental net benefit is negative; but from the 6th year onwards it would be positive and increase rapidly so that the value of the total incremental benefits over the 20 year period will be a substantial amount. The IRR of the project to the economy can be defined as the discount rate which just makes the sum of this present worth of incremental net benefits equal to zero (Gittinger, 1972:71). The IRR estimated using a trial and error method is approximately 17%. This is somewhat lower than the Project Paper estimate of 23.3%, but still higher than the 10% opportunity cost of capital employed in economic analysis by the Central Bank of Ceylon and the figure of 13% estimated for Sri Lanka by Deepak Lal (Project Paper, 1972:50).

The difference between the two estimates of IRR (17% and 23.3%) is due mainly to differences in the actual costs and the assumptions employed in two estimates. The capital expenditure used in the present analysis is higher than the Project Paper estimates, both due to increased allocation of funds and exchange rate variations since 1979.

The most important assumptions employed in the present analysis are;

(a) Maximum cropping intensity 165%
(b) Maximum yield: 94.5 bushels per acre
(c) Labour shadow price adjustment factor 50%
(d) CIF price of rice : Rs. 5,078 per metric ton converted to paddy price of Rs. 74.17 per bushel.

The above estimates used in calculating the IRR can be regarded as modest and have been based on observed trends and reasonably realistic assumptions. Hence, It would be useful to test the earning capacity of the project using a sensitivity analysis. In this context, the four assumptions used in the above analysis are changed to test the sensitivity of the IRR under (i) high values and (ii) low values.

Table 5.8

Incremental Net Benefits

Year	Incremental Gross Benefits(Rs.1000)	Incremental Gross Costs (Rs.1000)	Incremental Net Benefits (Rs.1000)
1	46,282	103.201	-56,919
2	-816	63,098	-63,914
3	32,116	105,374	-73,528
4	17,207	118,892	101,685
5	131,578	228,908	-97.330
6	124,309	79,094	-45,215
7	149,230	82,390	-66,840
8	187,873	103,006	-84,867
9	222,139	121,287	100,852
10	243,723	132,802	110,921
11	262,117	142,615	119,502
12	275,097	149,461	125,636
13	277,915	151,044	126,871
14	286,445	155,594	130,851
15	289,040	156,979	132,061
16	286,222	155,476	130,746
17	283,329	153,932	129,397
18	280,437	152,389	128,048
19	277,618	150,885	126,733
20	274,281	149,105	125,176

(i) The high alternative would assume:

(a) Maximum cropping intensity of 175% and therefore the total Gross Sown Acreage remains around 108,500 which was achieved in the 5th year.

(b) Maximum yield per acre gradually increasing from 5% in the 6th year to 10% in the 8th year and then increasing at following rates: 8%, 5%, 5%, 3%, 2% and at 1% until the 20th year to 100 bu/ac.

(c) Labour shadow wage rate is assumed to be 75% less than the market wage rate.

(d) Shadow price of a bushel of paddy assumed to be equal to average open market price of Rs.80.00 in Sri Lanka during the year 1984.

These changes give an IRR of approximately 24%. The assumptions (a) and (b) are too optimistic, but under the present improved water management and district level yield data (if these can be accepted as accurate) are not altogether impossible. The low alternative, on the other hand, presents a very pessimistic view of the future production levels. These assumptions are;

(a) Maximum cropping intensity: 150%, and the Gross Sown Acreage remaining at 93,000 acres from the 6th year onwards.

(b) Maximum yield per acre: increasing at 5% from the 5th year until 12th year and then remaining constant at 85.1 bushels per acre.

(c) Shadow price of labour: 30% less than the market wage rate

(d) Value of paddy: taken to be equal to the guaranteed floor price of Rs. 70.00 from the 6th year.

The IRR estimated employing the low alternative assumptions is 7%, which indicates that the project worth is less than the postulated opportunity cost (10%) of capital in Sri Lanka. The low alternative situation, though may be regarded as an extreme case can arise due to a number of negative developments affecting the performance of paddy agriculture over a period of time. These are: (a) Sub-division of paddy holdings into uneconomic operational units; this process which had already begun with the second and third generation members inheriting smaller plots of land may lead

to low land productivity unless adequate measures are taken to intensify agriculture; (b) A possible decline in the capacity to irrigate a larger area of the Left Bank; this depends to a large extent on the maintenance of the rehabilitated infrastructure and increased efficiency in water saving. It has been pointed out that the present level of annual funding for maintenance does not meet the requirements of the Left Bank (Blank, 1986:4). The operating and maintenance cost would be substantially higher for the Left Bank system where the newly installed structures and operational procedures are of a more sophisticated type than before.

Concluding Remarks

This analysis has attempted to evaluate the production benefits and the rate of return to capital invested in infrastructural modernization and water management efforts in the Left Bank. An internal rate of return of 17% was estimated by taking to account the behaviour of certain critical parameters such as: cropping intensity, resource utilization, and prices of inputs and outputs. It was implicitly assumed that the already achieved irrigation efficiency would be maintained and perhaps, will be enhanced over time.

In the light of the discussion presented, it becomes clear that much of this expected achievement depends on a number of factors. Most important among them are;
(a) the system's ability to maintain its improved capacity to control and deliver adequate amounts of irrigated water to the farmers;
(b) the degree of participation by farmers in water management at farm level and above (c) efforts made towards the increased and efficient use of agricultural inputs and to improve cultivation practices. The first relates to the capacity of the system's operators to maintain a complex and highly capital-intensive irrigation infrastructure. This requires a substantial allocation of funds, and therefore, raises a number of issues such as whether farmers should bear part of the cost, and their ability and willingness to contribute. The second depends on a number of factors such as the capacity of the farmers to manage the socio-technical processes of irrigation and to continue to do so in the absence of, or after the withdrawal of the catalysts (see Uphoff, 1986).

The third is most important, and it cannot be taken for granted that land productivity would increase once the major constraint, i.e. water shortage is resolved. It has been often pointed out that the farmers' efforts to increase investments in agriculture should be augmented by paying adequate attention to the provision of extension services, agricultural credit, marketing facilities etc.

Chapter VI

A BROADER ASSESSMENT OF PROJECT IMPACT

In this chapter, we go beyond the direct data on water distribution, cultivation practices and agricultural production to consider other indicators of project impact. We look at farmers' own assessments of changes in their income and status using opinion survey methods, and also various data from surveys reflecting any changes in quality of lfie. Consideration is also given to possible indirect benefits through contributions to regional development and thereby to a self-sustaining process of economic growth and employment generation. We conclude with a review of any improvements in access to public and private services.

Perceptions Change in Agricultural Yields, Income, and Quality of Life

Getting systematic data on intended beneficiaries' own assessments of their condition is useful in assessing project impact both to see whether subjective opinions confirm what are though to be the objective outcomes, and to evaluate whether positive attitudes have been established among the public. Accordingly, our survey of a random sample of 250 LB farmers sought to ascertain perceptions and opinions on project-related matters.

Although there has not been a consistent improvement in yields over the life of the project, as discussed in Chapter 3, in part owing to climatic conditions, it is worth noting that farmers definitely believe there has been an improvement. 71% of the farmers interviewed in the survey feel that the current typical maha yields of farmers in their area are higher than they were five years ago. Similarly, 67% feel that yala yields have increased, though this is more strongly the sentiment in the upper reaches of the system than in the middle and tail, where a number of farmers report a decrease in typical yala yields for farmers in their areas.

Seventy-three percent feel that their agricultural incomes have increased or increased greatly; while 56% felt that there has been a positive change in their quality of life in the past five years. We gathered data

on household income at present in the Left Bank and these are shown in Table 6.1. We recognize that survey data on income are laways liable to some error, and specifically we know that our sample, covering farm households, would not incldue families with no access to land, whose incomes would likely to considerably worse than thsoe reported in Table 6.1. With these qualifications, we report our household income data which indicate that most farm families are doing fairly well financially.

This would be consistent with the indirect evidence on increased employement and income opportunities resulting from expansion of the area under irrigation since 1983. Additional yala cultivation of 28,700 acres during the season would require additional labour in the range of 997,600 man-days. Approximately 52% of this labour would have been family labour, and 8% exchange labour. The remaining 40% represents about Rs.10 million in income for Left Bank households as the total value of incremental labour would be about Rs. 24.7 million valued at market prices.

Table 6.1

Distribution of Left Bank Households by Income Class Interval, 1985 Yala (in percent)

Gross Total per Capita Income (Rs) (6 months)	Head Units (2, 18/19 & (22/23/24) (N=122)	Middle Units (10, 33 & 34/36) (N=98)	Tail Units (32 & 28) (N=60)	Overall (N=280)
150-300	4.8	0.8	3.8	3.6
301-500	14.1	7.1	2.5	10.0
501-750	12.1	9.0	1.2	9.6
751-1000	12.2	8.0	6.3	10.4
1001-2000	27.7	34.0	36.3	32.5
2001-3000	14.1	19.1	23.8	16.8
3001-4000	7.5	7.6	8.8	7.9
4001-6000	3.1	8.3	10.0	5.7
Over 6000	2.3	5.9	7.5	3.6

It is interesting to note that although fewer of the farmers in the middle and tail areas of the system reported significant changes in yield, a larger proportion of them felt that their quality of life has improved over the past five years. Whereas 63% of the head-enders reported improvement in quality of life. 71% of the middle farmers and 100% of the tail-enders made this judgement about their condition. Smaller increments may mean more to those who have less to begin with.

The responses to our question, "how has the farmers' ability to help themselves changed in the past five eyars?" support this interpretation. We would expect head-enders to perceive less of a gain from the rehabilitation itself, and perhaps to feel some loss when through better irrigation system management by the ID and farmer organizations, head-end water use becomes more restricted. Only 36% of the farmers at the head of the system reported that farmers are now more of much more self-reliant, whereas 70% of those in the middle and 100% of the tail-enders gave that response.

What effect has the IO programme had? Though the distinction between field channels with farmer organizations and those without is not clearcut since most non-organized field channels border an organized channel, and could feel some spillover effects of the organization, there is a consistently more positive response to the question about self-reliance among farmers in the head, middle and tail areas that have organizations compare to the respective un-organized areas.

In general, then, farmers feel that they are better off now than they were five years ago. Though one cannot attribute this perception solely to the rehabilitation project, farmers give it a significant amount of the credit. To a specific question, "how has the rehabilitation of the Gal Oya Left Bank changes your hopes for the future?" 72% responded that they have more or much more hope than before.

Indicators of Rural Welfare

Housing

Unfortunately , the sample farmers for the baseline survey (1980), the mid-project impact assessment (1983) and the end-of-project

survey (1985) are not comparable enough for valid comparisons of the data. The 1980 survey selected sample households from a list of allotment numbers provided by the Cultivation Officers. This left out households on encroached lands and private lands, many of whom are second and third generation settlers with low incomes and living standards. The 1983 survey covered the head and middle areas of the Left Bank, Uhana and Gonagolla, where the rehabilitation had been implemented, as there was no 'impact' to be assessed elsewhere by that date. It represents a better-off sample of households than from 1980. The 1985 Yala survey, with a randomly selected sample of households from the entire Left Bank can be regarded as a more representative one. In this survye, 22% of the sample households lived on encroahced lands, for example.

For some other comparisons to assess impact, the differences in sample are not so serious. If 1985 data show an improved situation given the nature of the previous samples, one can have some confidence that there was a positive impact. On the other hand, with regard to housing and other amenities, where in any case there is likely to be some lag in impact, one cannot say much from a comparison of the data sets. We thus present the statistics inTable 6.2 to help clarify the picture of living standards in the Left Bank area, not really to show or assess project impact.

Table 6.2

Housing Quality in Left Bank (% of households)

	1980 Baseline Survey (N=168)	1983 Mid-Term Impact Survey (N=177)	1985 Project Impact Survey (N=284)
Category			
Permanent	32	48	34
Semi-Permanent	62	29	37
Improvised	6	23	29

Permanent housing has floor, walls and roof amde of materials such as concrete and tile; semi-mermanent housing has one of these three features

consisting of less permanent materials; improvided housing consists of temporary materials such as cadjan, or wattle and daub. From Table 6.2,one can see the effect of inlcuding squatters and encroachers in representative proportions.

We tried to 'control' for differences in the samples by comparing the 1983 results with the 1985 responses from head and middle areas. The percentages for this sub-sample (N=195) are: permanent 41%, semi-permanent 37%, and improvised 22%. This gave no basis for concluding that the project had had any demonstrable effect on housing quality. Since it may take some time for income effects to be translated into investments in assets like housing, there could still be some project impact on housing quality in the Left Bank. But it will become harder and harder to establish any direct connection.

Domestic Water Supply

One of the project's original objectives was to improve domestic water supply in the Left Bank of Gal Oya, a crying need at the time of the project's design. It is difficult to assess any change in domestic water supply (quality and adequacy) without resources for a specific study of this sector. The data from our 1985 survey, when compared with previous data, do not any evidence of improvement.

Table 3

Source of Domestic Water Supply (% of households)

	1980 Baseline Survey (N=168)	1985 Project Survey (N=280)	Impact (N=195)
Drinking Water			
Well	91	95	93
Irrigation Channel	06	05	07
Other**	03	-	-
Bathing Water			
Well	22	38	32
Irrigation Channel	66	64#	73#
Other	12	18	2

* Responses from head and middle only
** Includes tanks, rivers and piped water
\# This includes those who use both wells and irrigation channels.

There appears to have been no impact on sources of drinking water, though some shift to wells as a source of bathing water, implying a possible improvement in water quality for that purpose. Probably the main effect of the project on domestic water supply has been to contribute in part to the more ample distribution of water during yala season in the lower reaches of the Left Bank during 1984 and 1985. The prime factor was the more abundant natural supply, but rehabilitation and management contributed something to this. With such distribution, the supply of water in channels was greater and more widespread, and the water table serving wells would be higher. In terms of direct improvement of domestic water supply, there is little that can be claimed for the project.

Amenities

Two commonly used indicators for improvement in quality of life are provision of sanitary toilet facilities, which improve hygiene and health, and of electricity, which brings many benefits of convenience, security, etc. As seen from Table 6.4, there appears to be some improvement for Left Bank households, but how much of this can be attributed to the project's impact is not clear.

Table 6.4

Toilet and Electricity Facilities (% of households)

	1980 Baseline Survey (N=168)	1985 Project Survey (N=280)	Impact (N=195)*
Having Toilet	72	66	85
Having Electricity	6	17	24

* Responses from head and middle only.

Distribution of Benefits

The present situation in the Left Bank of Gal Oya still reveals considerable disparities in living conditions between the head, middle and tail-end parts of the system. As can be seen from Table 6.5, the indicators of quality of life are quite low in the tail-end areas compared with those for the head and middle areas. It is noteworth that the head areas

are not always the best off relative to the middle reaches, reflecting the less developed situation still in Unit 2 at the very head of the system after over 30 eyars of settlement. Some of the middle areas have had relatively better water availability despite their geographic location (Svendsen and Wijayaratna, op.cit.). It can be hoped that with better water distribution and supply for the tail now possible, the gap will be narrowed in coming years.

Table 6.5

Distribution of Socio-economic Indicators (% of households)

Indicator	Head	Middle	Tail	Left Bank Average.
Housing:				
Rooms: more than 2	30	49	11	30
Roof: tiles/sheet	66	76	48	64
Floor: cement	49	70	36	51
Walls: brick	57	79	52	62
Toilet: available	79	91	22	65
Drinking Water: own well	34	61	45	44
Electricity	19	30	2	17
Disease (No. of cases)				
Diarrhea	4	18	75	97 Total
Malaria	13	69	16	98 Total

Source : 1985 Project Impact Survey.

Income, Employment and the Economy

The income effects of paddy production increases were discussed previously, but they should be considered also in the context of regional development. As reported earlier, 73% of farmers feel that their agricultural income has increased. What if any implications does this additional money have for the regional economy? The rehabilitation effort itself would have had at least some effect by creating temporary jobs. The rupee value of the local contracts given exceeded Rs.40 million. Most of this was spent for local labour and material supplies. Planners and policy-makers hope that this money would be re-invested in productive assets and job-creating enterprises. Frequently the bulk of such expansion comes in the service sector (non-agricultural activities).

consistent with the effects of production and income gains in the agricultural sector reported by respondents and seen from farm-level data, and such gains could support economic diversification and employment generation. That respondents do not report much of the latter could reflect 'outsiders' taking up many of the jobs created, a perception frequently voiced. An end-of-project survey by itself cannot capture or demonstrate such complex economic and institutional interactions. A more inclusive assessment would require a full-fledged study of just such relationships .

Access to Services

There seems to have been a very definite improvement in the availability of inputs and marketing channels from the private sector (see Table 6.6). At the same time, there is a strong consensus among farmers that getting credit from the cooperatives and selling paddy to the Paddy Marketing Board has become more difficult in the past 5 years. These are both problem areas which have been glossed over in the past. Once water is no longer the binding constraint on the Gal Oya farming system, other problems such as credit may become more obvious.

It is worth noting that almost half our respondents said that getting credit from banks is now more difficult. In general, people perceived that government sources of agricultural inputs have either not changed significantly over the past five years or have gotten worse. The exception is 'getting extension advice', where 68% of farmers felt the situation had improved.

According to the 'complementary plan' prepared by the government to be implemented as part of its contribution to the Gal Oya Water Management project, there should have been an across-the-board improvement in the availability of credit, agricultural inputs, marketing and extension facilities. Credit is available through informal private channels, but as usuorious (20 to 25% per month), which offer no encouragement to use it for financing agricultural inputs or other improvements. The credit situation in Left Bank has been studied separately and reported in a special study referred to at the end of Chapter 4.

Such changes would have to be documented and measured by a very different survey and method than we were able to carry out for the project impact assessment. Collecting data from and on business activity is always difficult even for government officials. So we have had to settle for more indirect indicators. Non-agricultural activities still constitute a minor share of the local economy. Of those households in the record-keeping sample (which certainly has an agricultural bias), only 8.5% earn more than 50% of their household income from non-agricultural activities. The proportion getting some share of income from such activities is however more than half. Taking the whole population of the Left Bank, non-agricultural activities. The proportion getting some share of income from such activities is however more than half. Taking the whole population of the Left Bank, non-agricultural activities may well be up to 20% and this represents some change over the earlier situation, though we cannot say by how much or even for certain, how much is definitely attributable to the project.

There is no consensus among respondents to our survey on employment affects,whether job opportunities have increased, decreased or remained the same over the past five years. Most said they had remained the same or decreased. On the other hand, as seen in Table 6 below, there is a strong consensus on increases in the availability of consumer goods and services. This is also evident to any observer of the local scene. Such increases are not sustainable significant increases in income in the community, which also means increases in employment, which will be partly non-agricultural to service the growing commerce. The economic expansion certainly reflects island-wide policies and dynamics, not just project effects, and we cannot separate out the latter without elaborate and expensive economic model building. Even then the figures would still be estimates.

There is no evidence that economic changes in the Left Bank are greater or more rapid than in other comparable areas, or that they would not have occurred with any other infusion of Rs. 40 million into the local economy. On the other hand, economic and employment improvements are

: Farmer Assessments of 'Changes' in Gal Oya Left Bank

s to question: "How do you feel that your situation (amount, ility) has changed in the past five years with regard to the ing?"

		Percent of farmers reporting situation			
		Improved (A)	No Change (B)	Worsened (C)	Net Difference (A-C)
	Total agricultural income	73	24	4	+69
	Total non-agric. income	26	44	30	-4
	Employment opportunities	8	49	44	-32
	Access to banking/savings facilities	27	43	30	-3
5	Access to selling points	67	25	7	+60
6	Availability of consumer goods and services	54	43	3	+49
7	Getting fertilizer from government sources	35	41	25	+10
8	Getting fertilizer from private sources	84	15	1	+83
9	Getting weedicides from government sources	33	36	31	+2
10	Getting weedicides from private sources	83	17	0	+83
11	Getting insecticides from government sources	33	36	31	+2
12	Getting insecticides from private sources	78	21	1	+77
13	Getting credit from crop	15	30	55	-40
14	Getting credit from banks	20	31	49	-29
15	Getting extension advice	68	20	12	+56
16	Selling paddy to PMB	8	30	61	-53
17	Selling paddy to private traders	84	15	1	+83
18	Growing crops other than paddy	26	55	19	+7
19	Public services (average 7,9,11,13,14,15,16)	30	32	38	-8
20	Private services (average: 8,10,12,17)	82	17	1	+81

Best Available Copy

Source - 1985 Project Impact Survey
(N = 280)

Similarly, the price paid by private traders for paddy is a continuing source of complaint, though it is true that producers around the world are seldom satisfied with the prices they receive. The private sector is made attractive mostly by the obstacles and difficulties of the state sector channels, deserving a special study of their own, as suggested at the end of the previous chapter. Given the manifest improvements in water distribution and availability now attainable in the Left Bank, one might have expected use of modern practices and paddy yields to have increased substantially more than there is any evidence of.. This 'gap' gives some credence to farmers' reports of deficiencies in the public sector provision of credit, inputs and marketing services and it takes away some of the satisfaction that might be inferred from the 'availability' of these things through private channels.

Summary

Farmers perceive that they are better off now than they were five years ago. Yields and paddy incomes have increased over the project life for a majority, and most feel more self-reliant and hopeful for the future than they did in 1980.

Likewise, there is a strong sentiment that the private sector is offering options which were not available before, but that government services have not imporved. Extension services are the exception to this.

From data on housing quality and amenities, as well as on possession of agricultural implements and transport vehicles (not reported in detail because they showed no consistent pattern), one cannot determine any significant changes in living standards. however, if there are to be such effects from the project, they will be in future and will be even more difficult to attribute to the project.

A majority of 'farmers (56%) report an improvement in their quality of life, but this may not be much different from the national average. Gal Oya residents may lose some of their enthusiasm once the excitement

of the project and the first-round effects of project investments and national economic policies contributing to the satisfaction thus far wear off.

Agricultural credit and agricultural marketing are the problem areas most often identified by Gal Oya farmers as having worsened. They are likely to remain as problem areas unless more specific attention is paid them by government.

CHAPTER 7

EPILOGUE - SUMMARY FINDINGS AND THE LESSONS LEARNED

The future projects of this nature would be benefited not only by the successful features but also from the analysis of the weak aspects of this undertaking. In this section we will highlight some of the important lessons that could be drawn form the Gal Oya Water Management Project. First, we will summarize the major findings of the project evaluation efforts. This will be followed by an account on the notable constraints encountered during the planning, implementation and evaluation phases of the project.

7.1 ASSESSMENT OF PROJECT IMPACT

7.1.1 Physical Rehabilitation and Hydraulic Performance

Hydraulic performance of the Gal Oya LB system has been substantially improved by the rehabilitation work. Most of the main, branch and distributary canal system are renovated. The conveyance, control and measuring capacities of these canals in the main and distributary systems have been improved significantly. Consequently the main system is now conveying water more efficiently compared to the situation prevailed prior to rehabilitation. For example, as a result of rehabilitation the main canal now supply water to irrigate 24, 290 ha (60,020 Ac). However, a significant portion of the field channel work is yet to be completed. The progress of rehabilitation work is indicated in Table 7.1 below.

Table 7.1 Progress of Rehabilitation Work

	Estimate in Km.	Completed as of End 1985 in Km.	Progress as a Percentage
1. Main Canals	41.2	41.6	100
2. Branch Canals	100.2	103.0	100
3. Distributary Channels	437.0	436.0	100
4. Field Channel	1080.0	86-145*	15-25
5. Drains	487.0	47.0	10

Source - ISTI Evaluation, December 1985.

Notes: *145 refers to structures and 86 to earth work.

Field channel work involve both structures and earth work. Hence it would be difficult for farmers to complete this work without the support of the Irrigation Department. On the other hand the ID is faced with financial problems in rehabilitating field channels as much of the cost involved in this work has to be met by the normal O & M budget.

7.1.2 Water Distribution and Crop Yields.

A significant difference over seasons cannot be seen in regard to the "adequacy" and "equity" of water distribution in the GOLB area. (See WAI figures presented in Chapter 5). This may partly be due to the fact that water has managed or controlled in this system by reducing the amount of acreage irrigated in seasons of shortage (and vice-versa) to maintain approximately the same level of water availability per unit of land irrigated.

In addition, the WAI information presented in Tables 3 and 4 are not adjusted for seasonal fluctuations in rainfall or tank storage. Hence, the evidence of the project's impact on the adequacy and equity of water distribution is inconclusive to date.

However, both the extent cultivated and the productivity per unit of land have been increased, especially over the past couple of years. As for the extent, the anticipated increase was about 2,000 ha. (5,000 ac.) in the seventh year since the implementation of the project. The actual increase was about 4,450 ha. (11,000 ac.) in the sixth year.

The cropping intensity has increased from about 120 percent in 1982 to about 180 in 1985. According to ISTI Evaluation, yields per acre have increased from an estimated 3,575 Kg./ha. (65 bushels per acre) in 1980 to 4,345 Kg./ha (79 bu./ac.) in 1985. However, based on the farm record-keeping/monitoring programme conducted by ARTI (which included sample crop cuts), the change in yield level appears to be from about 2,200-2,750 (40 - 50 bu./ac.) in 1979-80 to about 3,300 - 3,850 (60-70 bu./ac.) in 1985 - 86 [1]. ARTI data show lower yield levels but a greater rate of increase in yield over the life of the project.

As correctly pointed out by the ISTI report, there are four major variables that have affected yields: physical rehabilitation, organization of farmer groups, weather, and extension activities. The degree of association between the increase in yields and each of the following four factors (or others if any) is also not known.

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1. - This explains the major differences in Internal Rate of Return Values (IRR) computed by the two evaluation teams. This aspect is discussed later in this chapter.

(a) Timeliness of land preparation;

(b) Shortening the time between land preparation and sowing;

(c) Enhanced use of fertilizer;

(d) Improved weed and pest control.

The writer has observed a significant reduction not only in the time taken out only for land preparation, but also for other key farm operations.

Prior to the Water Management Project (1979-80 period), it was observed that the farmers in water-abundant areas tended to stagger cultivation to the greatest extent while farmers who cultivated purely under rainfed condition in the Gal Oya LB command area showed the minimum degree of staggering. (Wijayaratna 1982). The latter group had no alternative but to adjust themselves and complete planting operations with the use of initial rains, whereas farmers upstream, having an assured water supply were not compelled to do so. A comparison of 'Pre' and 'Post' rehabilitation levels of staggering of cultivation clearly shows a reduction in the 'degree of staggerin' of paddy cultivation during the project period. (Wijayaratna 1986).

However, in addition to the reliability and adequacy of water, certain other factors such as the availability of working capital, labour and draft power, fragmentation of holdings and personal problems may also influence the degree of staggering of cultivation practices.

As for the use of complementary inputs by GOLB farmers, the present study reveals that end-of-project levels of fertilizer use were about one-quarter higher than in the baseline year of 1980. However, the continuous farm record-keeping activity does not show any upward trend in the fertilizer use over the past four seasons (chapter 4).

Similarly, the impact of project on the use of other agro-chemicals is also not known for certain. Even though a reduction in the expenditure on these chemicals (per farm) is reported, the reasons for this is not clear.

7.1.3. Farmer Participation in System Management

Farmer Organization (FO) programme may be identified as the most successful component of the project under consideration. Farmer organizations in the GOLB have made significant contributions to the re-design and construction, operation and maintenance of the system.

Lack of farmer participation in system management and the communication gap between ID and the farmer were highlighted in pre-rehabilitation studies. For example, the Master Plan stated:

> ".... the farmers have absolutely no discipline water management and are accustomed to take all they want when the water flows by their head gates" (II - 37).

However, the ISTI evaluation had observed a remarkable change;

> "One of the most important outcome of this project is the change in attitude, communication and behaviour among farmers and government personnel have occurred in Gal Oya" (p. 4).

At present, almost all the farmers' groups adopt rotational distributions, water saving techniques and participate in "group-organized" maintenance activities. Minor repairs and maintenance work such as channel clearing etc., are done commonly by means of shramadana, a traditional method of mobilizing labour for community work. In some cases, the ID assists farmers by providing materials and technical expertise.

Using the farmers' knowledge of design and construction of channels etc. is considered to be a useful outcome of this programme. The farmers and engineers met to discuss redesigning of field channels, and a direct and frequently effective dialogue gradually emerged between farmers and ID staff.

A significant reduction in the disputes over water (among farmers and between farmers and ID) has been observed. A systematic way of handling disputes has also emerged.

At the end of the project period there were about 400 field channel organizations in the GOLB covering about 10,000 ha. In addition, a federation of organizations comprised of field channel, distributary channel, branch canal and project level representations has also been established.

The concepts and methods followed in the GOLB farmer organization programme, are being used widely by the Irrigation Management Division of the Ministry of Lands and Land Development in organizing farmers in major irrigation schemes of Sri Lanka.

7.1.4 Training

The two major in-country training components of the water management project are:

1. improvements in both pre-service and in-service training activities at the Galgamuwa ID training institute and

2. training under the farmer organization programme.

Improvements in the training activities at the ID training centre are very significant both the spatial and temporal coverage of this activity extend far beyond the project. Similarly, some of the pioneering training activities of the farmer organization programme, both formal and informal have a wider applicability. These included farmer, Institutional-Organizer, and officer training.

7.1.5 Benefit Cost Analysis

The ex-ante analysis of the Gal Oya rehabilitation project, as explained in the project paper, indicated that it should command high priority on economic grounds. Accordingly the project paper predicted and Internal Rate of Return (IRR) of 23% (USAID project paper, 1979: p. 40). This section intends to compare and contrast the findings of chapter 5 on the economic appraisal of achievements at the end of the project and the evaluation conducted by the International Science and Technology Institute Inc. (1985).

One of these study reports and Internal Rate of Return (IRR) of 47.4% (International Science & Technology Institute Inc; 1985) while the other estimates an IRR of 17% (chapter 5). This discrepency is due to differences in the benefit as well as cost assumptions. For example, Tables 7.2 and 7.3 compare the differences between the two studies in regard to production estimates.

The evaluation submitted in chapter 5 is based on actual data on area, crop yields, costs, prices etc. through year six. There are some substantial differences between its basis and ISTI's.

Table 7.4 below compares the different indicators used in benefit-cost evaluations by the project proposal, ISTI evaluation and the analysis presented in this report.

Benefit-cost analysis is the most commonly used technique in the assessment of performance of esisting projects and in the identification of the potential benefits of rehabilitation and improvements in management. Despite the fact that benefit-cost analysis has some merit in evaluating the <u>end effects</u> of a given project the general application of this technique - more often than not - is characterized by certain deficiencies:

a). ambiguous evaluations of benefits and costs;

Table: 7.2 Production Estimates in Study I

Year	Acreage Sown x 1000	Cropping Intensity	Net Acreage harvested x 1000	Yield Bu/Ac	Total Production Bu x 1000
1	42	129	50.9	60.0	3057
2	42	129	50.9	76.6	3903
3	42	129	50.9	84.9	4326
4	46	139	60.1	74.3	4468
5	50	179	84.2	67.4	5673
6	53	179	89.2	78.9	7039
7	53	164	81.7	76.0	6212
8	53	164	81.7	79.0	6458
9	53	170	84.7	81.0	6863
10	53	175	87.2	83.0	7240
11	53	175	87.2	85.0	7414
12	53	175	87.2	86.0	7501
13	53	175	87.2	87.0	7589
14-20	53	175	87.2	88.0	7676

Source - International Science and Technology Institute, Inc. 1985, p.c - 10.

Table: 7.3 Production Estimates in Study II

Year	Acreage Sown x 1000	Cropping Intensity	Net Acreage harvested x 1000	Yield Bu/Ac	Total Production Bu x 1000
1	74.8	121	60.4	59.5	4007
2	74.8	121	60.4	57.0	3404
3	79.8	129	64.4	57.3	3880
4	92.4	149	74.6	52.1	3716
5	108.5	175	87.6	60.5	5292
6	102.0	165	82.4	63.5	5230
7	102.0	165	82.4	68.0	5601
8	102.0	165	82.4	74.8	6161
9 - 20	102.0	165	82.4	80.8 -94.5	6655 -7783

Table: 7.4

Comparison of Different Indicators Used in Different Benefit/Cost Studies

	Project Paper	ISTI Evaluation	ARTI Evaluation
1. Area Sown	52,00 ac. of paddy; increases to 57,000 ac. by the 7th year.	42,000 ac.; increases to 53,000 by the 6th year.	74,800 in the first year; increases to 102,000 in the 6th year.
2. Cropping Intensity	129% for the first two years; increasing to 189 in the 7th year.	129% for the first 3 years; increasing to 175% in the 10th year.	121% for the first 2 years; increasing to 175% in the 5th year and 165% in the 6th and onwards.
3. Average Yield	52.5 in the first year; increasing to 66.9 in the 8th year and 85.4 in the 20th year.	74 bu/ac. in the first 6 years increasing to 88 bu./ac. in the 14th year.	59.5 bu./ac. in the first year; unevenly increases to 74.8 in the 8th year, 94.5 in the 20th
4. O & M Expenditure	Rs. 125/ac.	Rs. 125/ac.	Rs. 125/ac.
5. Cost of Production	Rs. 31.16/bu.	Rs. 31.16/bu in 1979 and Rs. 3500/ac as the current cost.	Rs. 33.30 in the first year, unevenly increases to 45.21 in the 4th year, Rs. 39.57 from the 5th onwards.
6. Price of Paddy	Rs. 58.43/bu (world market price - 1979).	Rs. 58.43/bu (world market price - 1979).	Rs. 74.17 (on the basis of CIF value of imports).
7. Indirect Benefits	Ignored.	Ignored.	Ignored.
8. IRR	23.3	47.4	17

b). debatable choice of an appropriate discount rate; and,

c). difficulty in the seperation of project and non-project effects, such as the influence of weather, complexity of externalities, and linkage effects.

For example, the extent to which benefits are correlated with project's implementation is questionable. As indicated earlier, the degree of association between the increase in yields and such factors as physical rehabilitation/farmer organization, weather and extension activities etc. is not known. Hence it is difficult to substantiate some of the assumptions made in the cos-benefit analysis and feel confident about estimated benefits in those 'before' and 'after' or 'with' and 'without' studies.

However, the figures related to the benefits presented in chapter 5 are, we believe, much more defensible. Sensitivity tests produced on IRR are ranging between 7% (below any realistic opportunity cost of capital) and 24% (very respectable rate of return) though the most defensible estimate, 17%, is certainly acceptable.

7.2 Constraints

7.2.1 Unrealistic Assumptions during Planning Phase

The project proposal was not based on a realistic knowledge of the system. In 1983, over two years after the inauguration of the project, the project paper was amended and even at this stage, reliable estimates of channel lengths were still not known. Table 7.2 & 7.3 illustrate this situation.

The reasons for this state of affairs could be many; the major ones would be:

(a). inadequacy of data

(b). increased costs due to internal and external inflation (that are difficult to predict with a sufficient degree of accuracy)

(c). extra work found at later stages.

(d). delayed design (and construction)

(e). unexpected problems like ethnic disturbances

(f). (to a lesser degree the) poor workmanship that needed reconstruction.

In addition, division of responsibilities of rehabilitation work was also not clear. However, farmers were never consulted about this in advance and no agreement was reached reprehend.

Table 7.5: Summary Funding History

($000)

Item	Original Project Paper	Project Paper Amendment	August 85 Rivision	Estimate as of end 1985
AID Grant	3,000	5,100	4,800	4,235
AID Loan	6,800	10,800	8,800	8,000
Sub Total AID	9,800	15,900	13,600	12,235
Host country	8,940	8,578	8,978	6,900
Grand Total	18,340	24,478	22,178	19,135

Source - ISTI Evaluation, 1985, p. 13.

Table 7.6 Length of channels in the Gal Oya Left Bank Irrigation System (in Kilometers)

Element	Original Project Paper	Project Paper Amendment	Actual
Main canal	51.2	41.2	41.6
Branch canal	80.5	100.2	103.0
Distributary channels	109.4	437.0	449.0
Field channels		1080.0	576.0
Drainage channels	not stated	487.0	487.0

Source - ISTI Evaluation, 1985, p. 14.

7.2.2 Inadequacy of Data

A rehabilitation project of this magnitude requires a good knowledge of original designs, canal discharges over time, and most of all, the extends cultivated in its command area. Even the minimum information on some of these key aspects for example on original designs, was absent. As indicated earlier, the lengths of different categories of channels were not known, and much less the extents cultivated.

Even at present, reliable estimates on the actual extent cultivated cannot be found. This immediately acts as a major constraint in computing economic gains in an acceptable manner. Moreover, this constrains efficient scheduling of the scarce water resource.

7.2.3 Quality of Construction Work

It was observed that certain structures (constructed through rehabilitation) were damaged by farmers on several occasions when they appeared to be obstructing

water flow and were judged to be inadequate (chapter 1).

In addition, many farmers interviewed by the writer complained about the bad quality of some of the work and associated corruption and malpractices. This is not uncommon in Asia. For instance, Robert Wade has described how the contracts in irrigation projects in our country are tapped for a share of contractor's profits, by fraudulent tendering procedures, allowing for low-quality work, etc. (Wade, 1982).

7.2.4 Inadequate Attention to Drainage, Re-use and Soil Characteristics

Neither the pre-rehabilitation situation in regard to drainage and re-use of water nor the effects of modernization on the existing drainage and re-use patterns were checked by the project under consideration. A careful analysis of drainage and re-use should be an integral component of any rehabilitation project.

In addition, the absence of a closer study of soil conditions and variability in productivity of water (due to spatial variability of soils) is also a major drawback in the water management project. Moreover, the nature of the plant-water-soil interactions in the field, irrigation-related problems such as salinity are yet to be studied. Obviously, the impact of rehabilitation on production can be influenced by these factors.

Most of the lands in Gal Oya are classified either as non-calcic brown soils or alluvial soils. Both the water retention capacity and fertility in general are poor in these soils. In addition, a wide variation in the soil texture is observed over space.[2]

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2. For example, Zolezzi reports:
the clay content ranges from 6% to 19% and the available water from 1.76 or 3.14 to 15.37. (Zolezzi, 1985:6).

By any standard, soils of Gal Oya LB system are poor rice soils. Hence, a programme of crop diversification - especially in areas where higher paddy yields are constrained by soil factors - may result in more efficient utilization of the scarce water resource.

7.2.5 Limited Impact of Rehabilitation on Production

An indepth analysis of farm level data (from a sample of about 200 farms over four seasons, 1980/81 wet to 1982 dry) found that non-water constraints were responsible for nearly 60 percent of the foregone crop yield. (Wijayaratna 1986).[3] As the direct major influence of the rehabilitation programme is limited to system-wide improvements in water availability, such a programme may not provide solutions to many of the non-water factors responsible for the yield gap.

For example, in the analysis of spatial distribution of water and crop yields, the above-mentioned study had observed that certain regions of the Left Bank system have technically - efficient production frontiers, represented by the highest production levels in a given range of "water availability", at a lower level than others[4]. Rehabilitation may not necessarily push these frontiers upwards as the factors responsible for the low levels of productivity. - e.g., soil quality - are beyond the scope of the planned efforts of rehabilitation.

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3. "Foregone yield" refers to the gap between achievable and actual crop yields.

4. Both the yield-water scatter diagrams and the magnitudes of the location dummy variables in the production function analysis showed that low yields are strongly associated with specific zones of the LB system.

Appendix 1 : Tables of the Chapter II

Table A1 : Uhana Area Farmer Organizations

D-Channel Organization	Number of FCOs	Number of VRs	Extent Covered	Number of Farmers
1. UB 2	19	27	1074	351
2. UB 3, 4, 5, 6, 6A	7	17	411	226
3. UB 7	11	16	519	235
4. UB 8A + 8	3	4	167	49
5. UB 9 + 10	13	15	850	268
6. UB 11 + 12	19	19	1046	490
7. UB 13, 14, 15, 16	6	10	395	91
8. UB 1, LB 14, 15, 16	16	19	602	239
TOTAL	94	127	5064	1949

Table A2 : **Gonagolla Area Farmer Organizations**

D-Channel Organizations (Formed)	Number of FCOs	Number of FRs	Extent Covered	Number of Farmers
LB 20, 21	07	10	347	149
LB 22 and Matayaya	19	34	1057	568
LB 29, 30, 31, 32	12	13	312	176
G 1, 3	07	08	337	183
G 2, 4, 7	07	09	558	163
G 5	05	07	216	86
G 9, 12	05	07	175	61
G 6	05	06	348	62
LB 38, 39	06	06	329	138
LB 40	05	05	191	90
G 10, G 10.1 - 10.6 (To be formed)	16	16	1186	234
G 11, 13, 14, 15, 16, LB 19 LB 23, 24, 25, 27, 34, 35, 36 LB 37, V 1-5, S 1-5	39	41	2354	813
TOTAL	135	162	7410	2723

Table A3 : Weeragoda Area Farmer Organizations

D-Channel Organizations	Number of FCs	Number of FRs	Extent Covered	Number of Farmers
UB 17, M 1, M 2, M 3, M 4	17	24	953	534
M 5.2, 5.1	11	15	821	234
M 5.4, 5.5, 5.6, 5.7, 5.8	21	24	1560	569
M 6, M 7	5	9	296	113
M 8	9	13	449	234
M 9, 11 + 11a	6	7	458	254
M 10, 12, 13, 14, 15, 20, 21, 22	13	15	1425	240
M 16 + M 18	14	14	3115	293
MS 1 - MS 8	12	14	1096	238
TOTAL	108	135	10173	2709

Table A4 : D-Channel Farmer Organization Meetings:

Frequency and Attendance

D-Channel Organization	Number of Meetings	Average Attendance	Number of Meetings Attended by Officers
UB 8 & 8.4 (5 months)	6	82%	4
UB 9 (27 months)	20	78%	12
LB 29, 30, 31, 32 (11 months)	11	94%	9
G 1 & G 3 (10 months)	3	98%	3
UB 16 (31 months)	8	98%	6
M 5.2 (23 months)	18	82%	11

Source - D-Channel Meeting Minutes.

Table A5 : Water Problems Reported by Farmers (% responses)

	Maha 1984/85 (N = 202)	Baseline Study (N = 475)
No Problems	45	13
Too much water	77	9
Shortage of water	22	55
Unreliable supply	26	29
No Response	-	6

Percentages sum to more than 100 because of multiple responses.

Table A6 : Water Problems Reported by Farmers (% responses)

	Yala 1985	Baseline Study
No Problems	56	3
Too much water	1	12
Shortage of water	22	73
Unreliable supply	21	25
No response	-	9

Percentage sum to more than 100 because of multiple responses.

Table 47 : Factors Contributing to Water Shortage, According to Farmers (% responses)

Baseline Study (N = 475)		Final Evaluating Survey (N = 53)	
Poor channel maintenance	36	Inadequate water in the system	23
Inequitable distribution	32	Poor channel maintenance	24
Stealing of water	22	Inequitable distribution	15
Officer ignorance/neglect	21	Damaged structures	11
Damaged structures	20	Officer neglect	6
		Other reasons	17
		Stealing of water	4

Table A8 : Farmer Perceptions: Why Farmers Waste Less Water Now (% responses)

	With FO	Without FO
1. Greater water supply	5	-
2. More reliable supply	15	22
3. Better channel maintenance	19	18
4. Better understanding among farmers	27	-
5. Clear understanding that excess water is not necessary	23	8
6. ID strict control	11	49
7. Others	0	5
	(N = 97)	(N = 37)

Source - Final Impact Evaluation Survey.

Table A9 : What Percentage of Farmers in Your FO Would Close Their Inlet Poles When They have had Enough Water?

(% responses)

	With FO	Without FO
1. All (100%)	15	4
2. Most (75%)	54	18
3. Many (50%)	15	5
4. Some (25%)	12	11
5. None (0%)	4	62
	(N=110)	(N=83)

Table A10 : Do Farmers Try to Save Water for Farmers Downstream

(% responses)

		After FO	
	Before FO	With FO	Without FO
1. Yes	5	78	12
2. No	63	9	58
3. Do not know	32	13	30
	(N=137)	(N=110)	(N=69)

Source - Final Impact Evaluation Survey.

Table A11 : Farmer Perceptions of the Prevalence of Damage to Irrigation Structures by Farmers

	Before FO	After FO
Yes	63%	3%
No	19%	77%
Cannot say	18%	30%
	(N=190)	(N=172)

Table A12 : Why Do Farmers Damage Structures Less Now Than Before? Farmer Representatives responding

1.	Greater harmony and understanding among the farmers within the field channel.	34
2.	Improved understanding of the functioning of the structures.	26
3.	Improvement of Farmer - ID relations	12
4.	Realization through participation in design meetings	7
5.	Greater sense of collective responsibility for the field channel and structures	5
6.	Improved and equitable distribution of water	4
		(N=128)

Tabulation of responses to an open-ended question.

Source - Final Impact Evaluation Survey.

Table A13 : Farmer Perception of the Effect at FO on the Prevalence of Conflicts (% responses)

Increased	0
Decreased	85
No change	3
Cannot say	12

(N = 110)

Source - Final Impact Evaluation Survey.

Table A14 : Channel Maintenance (% responses)

	Before FO	After FO
Very good	-	11
Good	7	54
Fair	12	27
Poor	49	3
Very bad	32	3
	(N=179)	(N=70)

Table A15 : Channel Clearing Method

	Yala 1985		
	Before FO	With FO	Without FO
No channel cleaning	7%	4%	7%
Yes - Shramadana	8%	26%	-
Yes - Individual lengths	80%	70%	93%
Cannot say	5	-	-
	(N=158)	(N=108)	(N=64)

Table A16 : Supervision of Channel Cleaning

	Before FO	After FO
Jalapalaka	4	1
Yayapalaka	90	10
FO/FR	-	73
IO	-	10
Others	6	6
	(N=197)	(N=110)

Source - Final Impact Evaluation Survey.

Table A17 : Water Management: Officers' Perception (N=30)

	Yes %	No %	Cannot Say %
1. Farmers waste less water now	50	40	10
2. There is more equitable distribution of water	70	23	07
3. There is among farmers a better knowledge of the system	53	13	34
4. Farmers show greater concern for the needs of the farmers below	46	16	39
5. There is less damage to structure by farmers	57	37	6

Source - Postel Questionnaire

Table A18 : Officers Perception at FO Performance on Water Management (N=30)

	Extremely well %	Moderately well %	Poor %	Cannot say %
Organising farmers for water management	9	50	11	30
Organising farmers for channel maintenance	10	43	23	24

Table A19 : Farmer Contact with Officers

(% responses)

	Before FO			After FO		
	No Contact	Unsatis-factory Contact	Satis-factory Contact	No Contact	Unsatis-factory Contact	Satis-factory Contact
ID	63	22	15	48	22	30
Agricultural Department	35	12	57	21	8	71
Agrarian Service						
		(N=215)			(N=168)	

Table A20 : Farmer Contact with Officers

(% responses)

Irrigation Department	No Contact		Contact Un-satisfactory		Contact Satis-factory	
	Before FO	After FO	Before FO	After FO	Before FO	After FO
Irrigator	40	27	30	22	30	51
WS	65	48	21	23	14	29
TA	62	41	12	15	26	44
IE	72	60	24	26	4	14
DD	76	62	22	20	2	18
KVS	33	20	7	5	40	75
CO	17	9	13	3	70	88
DO	53	33	16	16	31	51
Yayapalaka	9	27	3	11	88	62

(Before FO N=215) (After FO N=168)

Source - Final Impact Evaluation Survey.

Table A21 : Farmers Perception of Changes in the Attitudes of Officers (% responses)

	Before FO			After FO		
	Good	Fair	Poor	Good	Fair	Poor
Jalapalaka	30	38	32	50 (+66%)	34	16 (-50%)
W.S.	32	30	38	42 (+31%)	43	15 (-60%)
T.A.	33	29	38	53 (+60%)	32	15 (-60%)
I.E.	13	06	81	25 (+92%)	45	30 (-61%)
D.D.I.	10	08	82	40 (+300%)	32	28 (-68%)
K.V.S.	47	33	20	54 (+14%)	36	10 (-50%)
C.O.	52	41	07	65 (+25%)	28	07 (-0%)
D.O.	35	42	23	50 (+42%)	43	07 (-69%)

Source - Final Impact Evaluation Survey.

Table A22 : Officers' Perception of Improved Communication and Understanding

(N=30)

Percent Respondents

	Yes	No	Cannot Say
FO facilitates better communication between farmers and officials	63	16	21
FO have led to greater understanding and trust between farmers and officers	60	16	24
FO have given farmers greater confidence in their dealings with others	50	14	36

Table A23 : Officers Perception of FO Performance

(N = 30)

	Extremely well	Moderately well	Poor	Cannot say
Representing FO to outside agencies and other farmers	10	64	13	13
Communicating information from ID to farmers	16	64	0	20

Source - Postal Questionnaire.

Table A24 : Proportional Distribution of Length of Service among Institutional Organizers

Period Remaining in Service	Percentage of IOs
3 months or less	27
3 + months to 6 months	14
6 + months to 12 months	16
12 + months to 24 months	20
Over 24 months	10
Still in Service	13
TOTAL	100%